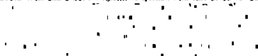
THE RHEUMATIC DISEASES

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By

G. D. KERSLEY
M.A., M.D.(Cantab), F.R.C.P.(London), T.D.
Director of Research and Adviser in Chronic Rheumatic Diseases to the *South West and Oxford Regions. Physician with care of Rheumatic*



WITH A FOREWORD BY

SIR FRANCIS R. FRASER
M.A., M.D (Ed.), F.R.C.P.(Lond.)
Post graduate Professor in Medicine to the University of London Consulting Physician to St Bartholomew's Hospital Director General of E M S Ministry of Health

THIRD EDITION



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PREFACE TO SECOND EDITION

In producing this edition, the text has been thoroughly revised and largely re-written in the light of advances in knowledge. In spite of the addition of much new matter, it has been kept as concise and practical as possible in order to cater for the needs of the over-worked senior student and busy general practitioner

In the introduction, the preventive and industrial aspect of the rheumatic diseases are discussed A new chapter on their inter-relationship and etiology has been added Also chapters giving a brief description of types of specific infective arthritis, and of conditions simulating arthritis have been included, both to assist in differential diagnosis and in order to throw light on the possible etiology of non-specific rheumatic conditions

The arrangement of the text has been altered and the classification of diseases has now been made on a combined basis of clinical syndromes and likely etiology. A classification on a purely anatomical basis becomes artificial and sufficient is not yet known of the pathology of many syndromes to allow the adoption of this latter method

The chapter on the description of methods of treatment has been completely revised, enlarged and brought up to date, and, where a treatment is applicable to a number of conditions, discussion of details has been confined to this final chapter in order to avoid repetition.

G D.K

March, 1945

PREFACE TO THIRD EDITION

In revising this book in preparation for a third edition, the same [illegible]

diseases, their treatment and what is known of the factors in their etiology, in as small a space as possible

Every section of the book has been brought up to date and a completely new chapter has been written on the endocrinological and

LIST OF ILLUSTRATIONS

been hitherto inaccessible, and from lack of which the me
treatment have been regarded as mysteries by most physicia

The medical profession as a whole has shown in recent yea
of consciousness that patients must be more carefully stud
cared for, and that the investigation and treatment of disease
alone enable them to carry out their duties and responsibilit
is recognised that the aspect of a malady varies at the differ
and stages of life, and that the clinical picture due to a
process in a child may be quite different from that due to t
process in an elderly person The numerous manifestations
and subacute rheumatism, or the rheumatic state, in the ch
been the subject of much study since the beginning of this
and this has served to emphasise the importance of the pa
the soil in the determination of clinical phenomena. At th
time it has thrown doubt on the accepted limitations of this
and re-awakened interest in the possibility of a close relat
between acute rheumatism and the various forms of chronic a
and fibrositis. Dr Kersley has therefore been wise to in
brief chapter on acute rheumatism, and has thereby indicat
in the present state of knowledge a wide view should be take
whole group of rheumatic maladies.

The student will find in this book a guide to the differen
of arthritis
consultant
extremely
find elsewhere, and the student, the practitioner and the inve
will find here a concise summary of practical knowledge and in
tion that should make a useful starting point for the new kno
that must certainly be acquired in the next few years.

1934. F. I

* * * * * * *

In the second edition of Dr. Kersley's book there is mu
matter that records the experiences of clinicians and r
workers since the publication of the first edition. In thes
war has affected almost every country in the world and inter
the work of physicians and laboratory investigators, and it
surprising, therefore, that there has been less advance in kno
of the cause and treatment of the rheumatic disease than
reasonable to expect when the first edition was written Alt

the war has interrupted the work then in hand and delayed results in certain directions, it has altered relative values and speeded up the acquisition of knowledge in others. A war, that demanded the greatest possible contribution from everyone and produced strain on the manpower of nations, required the restoration to working efficiency of each disabled person in the shortest possible time. If a man or woman, whether in the Forces or in industry, is prevented from returning to duty for a day longer than is necessary, there is loss to the nation's effort, and so treatment that is effective gains in emphasis, even though the cause of the disability and mode of action of the therapeutic measures are not clearly understood The war has drawn attention to the methods of treatment, and especially to the physical methods, that are available for restoring quickly to working efficiency the men in the Fighting Services and in essential industries, who have suffered from such diseases as sciatica and fibrositis It has resulted in these methods being made more generally available, and in more medical men and auxiliary staff

to, effective duties has emphasised the need for more knowledge and research. The importance of the personality, character and mental health of the individual patient suffering from pain, and the difficulty

and this has led to more accuracy in diagnosis and improvements in treatment.

These developments and these changes in emphasis are reflected in this new edition, which remains essentially a guide to practical clinicians It should prove invaluable for those general practitioners and specialists who will be required in the post-war years of reconstruction to provide for the rehabilitation and resettlement of sufferers from the rheumatic diseases The lessons of the war and the experience of the author in rheumatic ailments of the soldier are made available here for the benefit of the civilian and the industrial worker, and throughout the book the reader will see the gaps in our knowledge of the nature and causes of the rheumatic diseases and recognise the call for research in a field that means so much to our national health and efficiency

1945. F R FRASER

CHAPTER I

INTRODUCTION

THE term "rheumatism" originated from the idea that a "rheum" or harmful humour, flowing from the brain to the body, caused the many aches and "catarrhs" from which the human race so frequently suffers.

Gout was the first disease of the rheumatic group to take a prominent place in literature, probably because of its dramatic course and the fact that it so often affected the well-to-do and the learned. Both Hippocrates and Celsus describe this disease, but it was Radulfe in the thirteenth century who gave it its name

In the seventeenth century Baillou (1635) uses the word "rheum" to distinguish acute polyarthritis from gout, and a little later Sydenham (1676) wrote his classic description of acute rheumatism. It was not, however, until 1836 that Bouillaud established his thesis of the inter-relationship and pathology of heart disease and rheumatic fever.

In the year 1800 Beauvais first described rheumatoid arthritis under the title of "Goutte asthenique primitive"

Four years later Heberden (1804) and then Haygarth (1805) recognised the condition of osteo-arthritis as a separate entity Thus, for well over a century the main rheumatic syndromes have been defined, but we still do not know how sharp a line should be drawn between them.

In Great Britain one-sixth of the invalidity of the insured population is due to rheumatic disease, which is responsible for the loss of 3,000,000 weeks' work and some £2,000,000 to the country each year.

In Scotland, among the insured population, rheumatism came fourth on the list of disease groups causing chronic invalidism, following mental, respiratory and cardio-vascular disease in this rôle

Among the Middle East Forces, fit troops in a warm climate, rheumatic conditions constituted 2 5 per cent of 51,000 medical admissions to hospital.

In an analysis of a series of 1,000 insured persons who had been continuously incapacitated for more than three months, 14 per cent were suffering from rheumatism in some form or another ; of these

17 per cent. were suffering from osteo-arthritis, 13 per cent. from rheumatoid arthritis, 20 per cent. from acute or sub-acute rheumatic fever, 23 per cent. from other miscellaneous types of arthritis, 33 per cent. from fibrositis, 17 per cent. from sciatica and 18 per cent. from other conditions diagnosed as rheumatic neuritis (Department of Health for Scotland, 1943).

Yet the newly-qualified practitioner knows less of fibrositis and arthritis, the cloaks under which they can masquerade, and the value of various forms of treatment, than he frequently does of Cushing's syndrome and other rarities he is seldom likely to meet and which are frequently untreatable.

Under-graduate and post-graduate teaching on the rheumatic diseases is sadly deficient, but is slowly improving, and one aspect of treatment, that by physical methods, has received impetus from the recent establishment of a Diploma in Physical Medicine. This leads us naturally to consideration of the preventive and industrial aspect of the problem.

Fitness is largely dependent on such factors as peace of mind, interest, sufficient and balanced diet, sufficient rest, healthy living conditions, proper graduated exercise and exposure of the body to the fresh air. All these factors play a part in the reduction of the incidence of "rheumatism" and, in those predisposed to such troubles, they become even more important. Exposure of the skin, avoiding local chilling, not only acts as a powerful stimulant to metabolism, but assists in preventing that failure of reactivity of the superficial capillaries to change in temperature which, fostered by over-clothing, is so often prodromal of rheumatic disease. A bath, the temperature of which will vary with the individual and the temperature of the surrounding atmosphere, followed by a vigorous towelling, so that the final experience is that of a general glow, will have much the same beneficial effect on the capillaries. Good ventilation, without draught, is also very important

Exposure to ultra-violet light either natural, or artificial when the former is impracticable, is of value in raising resistance if properly graduated, but over-exposure may do more harm than good.

Graduation of exercise, both general and local, within the fatigue limits of the individual, is very necessary; and here the importance of selection of personnel for various jobs according to their physique, the posture necessarily maintained at their work, how it can be varied by height of benches and stools and the establishment of rest

periods, are all vital. Repetitive movements confined to a few groups of muscles and cramped posture must be avoided, or counteracted where unavoidable by regular special exercises. Only by consideration of these influences, together with optimum hours of work and spacing of holidays, can invalidity be reduced and the maximum output obtained with the minimum of effort

In the etiology of rheumatic disease there are probably many factors, and hence the campaign of treatment has often many sides [illegible]

for all these adjuvants to rehabilitation can only be provided for and properly utilised if consultative clinics are established on a regional basis and are visited by clinicians with special knowledge of the subject These consultants would then advise the practitioner on home treatment and make arrangements for the more simple physical treatment locally where possible.

The arrangement agreed to for the South West and Oxford Regions consists of (a) Peripheral Clinics of a consultative nature, set up to co-ordinate with the existing orthopædic system They will give advice to practitioners [illegible] at the major general hospitals Here a few beds will be available for short term investigation and treatment (c) Main treatment and research centres (d) Convalescent and rehabilitation units working in liaison with the orthopædic system (e) Care of the crippled and incapacitated This service will be co-ordinated with the care of individuals and geriatrics services

By such a scheme it should be possible to reduce the invalidity rate and the number of cripples very greatly and at the same time much valuable material for observation and research should become available

In addition, as Tegner (1940) points out, much may be done by proper organisation of a [illegible] vice. This would be [illegible] finding of suitable jobs [illegible] to continue home treatment and for follow-up schemes. Much can be done in the way of home treatment by means of insistence on adequate rest, suitable food, etc., and by hot mustard baths, contrast

hot and cold bathing, rubbing with rubefacients, self-applied mud packs made from Fuller's earth and the wearing of rubber gloves previously washed out with boiling water. These home methods may usefully act as substitutes for many of the more elaborate physical treatments only available in special physiotherapy departments, the daily travel to which would mitigate against any greater benefit the more extensive treatment might produce.

CHAPTER II

THE RHEUMATIC DISEASES, THEIR ETIOLOGY AND INTER-RELATIONSHIP

It is easy to suit the tidy-minded individual and to simplify teaching by subdividing the rheumatic diseases into a series of distinct syndromes, each in its own water-tight compartment. But are they distinct entities in which the only connecting link is that, in them all, the joints or peri-articular structures are essentially involved? Although a typical case of any of the rheumatic "diseases" is easily classified, the more rheumatic cases one sees the thinner the walls of the water-tight compartments between the syndromes seem to become Not only do many borderline cases between the different syndromes present themselves, but common factors in etiology are in some cases very striking. Without claiming a common origin, a few of the similarities are worthy of note.

Similarities in the Syndromes. Although both acute and sub-acute rheumatic fever of childhood usually presents a text-book picture, as adolescence approaches the incidence of heart lesions of fresh origin decreases and in adults a form of both acute and sub-acute rheumatism is seen in which carditis is rare but in which the joints still respond dramatically to full doses of salicylate These cases are not unlike many who eventually develop into a rheumatoid arthritis of the secondary, focal or non-specific infective type. Cases likewise occur which appear to link this latter group with the "primary" rheumatoid on the one hand and certain specific infective arthritis cases, especially those following gonorrhœal and "non-specific" urethritis, on the other Still's disease seems to be the infantile reaction to rheumatoid arthritis with the typical prodromal period of ill health, wasting and anæmia, but marked lymphadenitic reaction. In this condition carditis sometimes occurs but there is little or no improvement with salicylates Gout, usually looked upon as a very distinct entity, has much in common in etiological factors with the other rheumatic diseases, these factors acting in conjunction with the abnormality in purine metabolism Osteo-arthritis in the typical chronic form appears quite distinct, but its inter-relationship with villous arthritis of the climacteric is uncertain, and moreover, when symptoms are severe, they are usually partly due to a concomitant fibrositis. Osteo-arthritis is often

built up by subcutaneous injection and is often reduced by intravenous desensitisation.

Lichtwitz (1944) considers that rheumatism is essentially symmetrical sensitisation of mesenchymal tissues due to a lack of control of immune body formation by the autonomic nervous system Moreover, he suggests that later a conditioning of the synapses of the autonomic system to a particular pattern allows many other factors, such as mental or physical fatigue, to initiate recurrence or exacerbations of the rheumatic state.

One way in which allergy may be influenced by infection is illustrated by the fact that guinea-pigs infected with tubercle become more easily sensitised to other foreign proteins than healthy guinea pigs (Laurie, 1939) Lesions resembling Aschoff's nodes have been produced in the fascia, especially in localities traumatised by exposure to cold or fatigue, by injecting serum in doses calculated to produce an allergic reaction (Klinge, 1929 and 1933). Angevine *et als* (1942) produced arthritis in rabbits either with a single large dose intravenously of living culture of a haemolytic streptococcus, or by using a much smaller dose of killed vaccine either intravenously or intra-articularly, if the rabbit was previously sensitised

The period between the onset of an infection and rheumatic symptoms in rheumatic fever, rheumatoid arthritis and many cases of specific arthritis and fibrositis, and the response of rheumatic fever and gout to salicylates are reminiscent of the reactions of allergic conditions such as the joint manifestations in serum sickness. In rheumatic children infected with a streptococcus, the rise in antihæmolysin and other antibody titres is slower but more prolonged than in non-rheumatic subjects, suggesting an abnormal immune body response (Coburn and Pauli, 1939) Recurrent attacks of gout may discontinue for many years after forbidding one or more specific articles of diet, often foods of low purine content, or after removing a focus of infection Cases of fever with polyarthritis and conjunctivitis occurring on administration of sulphonamides to sensitised individuals have been described (Moeschlin, 1942). All these pieces in the jig-saw do not yet make the picture, but perhaps we are beginning to see the vague outline.

A reasonable working hypothesis, that covers the known facts as well as any other, is to consider those suffering from rheumatic disease as a group with poor serological response to sensitisation or immune body formation.

In the child cellular sensitisation may be produced by a hæmolytic

streptococcus with or without a concomitant virus infection and a particular mesodermal reaction then occurs, the state being known as acute rheumatic fever. In the adult a similar slow response in immune body formation, perhaps engendered or increased by fatigue, worry, shock, or chronic infection, may be ingrafted on other abnormalities such as a dyscrasia of uric acid metabolism or endocrine or sympathetic-parasympathetic instability. When such a subject becomes sensitised to a chronic infection, either bacterial, virus or a combination of the two, to a food or even to a drug, the condition of rheumatoid arthritis or gout may result. Local trauma or any physical cause of local hyperæmia will then establish the site of the attack in the same way that hyperæmia will determine the site of an Arthus phenomenon of focal necrosis on intravenous injection of antigen into a sensitised animal.

One other recent piece of experimental work in the immunological field may throw some light on the fundamental process of eumatism Calveti (1947) has attempted to produce tissue pecific auto-antibodies and hence localised tissue damage, by immunisation using dead streptococci plus an emulsion of the same type of tissue as that to which the "allergic" reaction is to be localised.

He has had some success in animal experimentation using renal and heart emulsions, but this work will require substantiation and follow-up. It is, however, of great interest in connection with the possibility of trauma rendering a joint tissue antigenic and hence the production of auto-antibodies. Such a process could occur in those cases where a typical monarticular traumatic arthritis suddenly develops into a typical polyarthritis with all serological and other stigmata

In many cases of osteoarthritis traumatic and degeneration changes appear to be the predominating factor, but in some, for instance in so-called "acute" osteo-arthritis, there is little doubt that a tissue response similar to that of the previously considered group also exists

In fibrositis it is even more difficult to generalise—some cases are hysterical conversion syndromes, some are due to changes within the spinal canal, but a proportion are probably of the same pathology as that which we have just been considering—something resembling an Arthus phenomenon, leaving in its wake a small scar subject to re-activation by physical as well as chemical traumata and which then produces the vicious circle of pain, muscle spasm and ischæmia.

function) and includes desoxycorticosterone and a compound present in the amorphous fraction. They are used mainly in Addison's disease. Group II control carbohydrate metabolism and increase resistance to stress. They include only those hormones which have an oxygen atom attached at carbon atom 11 and their potency is increased by a hydroxy group at 17. They are corticosterone, 11-dehydro-corticosterone, 17-hydroxy-corticosterone and 17-hydroxy-11-dehydro-corticosterone. The latter is Kendalls' compound E and Reichsteine's Fa compound $C_{21} H_{28} O_5$. It has been suggested that these four crystallised compounds may all be stable derivatives of a less stable true hormone.

Fig 1 shows the structure of some of these compounds and also that of androsterone and cholesterol for comparison.

The function of these group II steroids appears to be to influence oxidation of glucose in the peripheral tissues and the formation of carbohydrate from amino-acids and their residues after deamination (Long, 1942) Excessive administration of compound E is said to produce diabetes in rats (Ingle, 1940–41) and the Selye "alarm reaction" has also been produced experimentally by its ingestion. No tendency to this has been observed in human beings, though a reducing substance is sometimes found in the urine.

The alarm reaction (Selye, 1936) occurs under stress and at first causes involution of the thymus, spleen and liver, loss of cortical lipoids, accumulation of transudates in the pleura and peritoneum, decrease in muscle tone, drop in temperature and ulceration of the gastro-intestinal tract Urine output is decreased and there is hypoglycæmia Subsequently the animal builds up a resistance and recovers temporarily, though, if the stimulus continues, this resistance is again lost and death follows in a state of exhaustion.

The adreno-cortical steroids were first brought into the picture in connection with arthritis by the claim by Selye in 1946, that the group I compounds experimentally produced arthritis, poly-arthritis nodosa and nephrosclerosis in rats This has, however, not been confirmed by Harrison.

Now in 1949 comes the discovery of the therapeutic effect of the group II steroids, especially 17-hydroxy—11-dehydro-corticosterone (compound E), the acetate of which is now named cortisone by Merck, and of the anterio pituitary adreno-cortico-trophic hormone (A C.T H Armour) in rheumatoid arthritis (Hench, Kendall, Slocumb and Polley, 1949) This work was initiated by a study of the temporary reversability of the rheumatoid process as the result of

such divers factors as pregnancy, jaundice, anæsthesia and surgery, and it was thought that a cortical hormone might be the connecting link.

Cortisone. Work on the 11-oxysteroids in connection with rheumatoid disease was first started at the Mayo Clinic in 1941, but it was not till 1948 that promising results were first obtained.

Their synthesis was extremely difficult and the first samples of Compound E were obtained from Compound A. They are now being synthesised by the use of thirty-five separate processes or stages from desoxycholic acid in bile by Merek Inc., at an initial cost so high that it is estimated that two weeks' treatment is costing about £4,000 per patient This is, of course, only a temporary phase, but it is obvious that cortisone will not be available for use outside investigational centres until a more simple method of synthesis is available. Preparations from the plant, strophanthus sarmentosus and possibly yams, is also under consideration, but from these sources cortisone will not be available in any quantity for at least some years

The effect of administration of cortisone is to increase the excretion in the urine of 11-oxy-steroids, increase excretion of sodium chloride and urates, the latter measured by the urine urate/creatinine ratio, and to produce a fall in the eosinophils and lymphocytes in the circulating blood 17-keto-steroid excretion is usually decreased.

The hormone is administered intra-muscularly in an aqueous finely-ground suspension and will be put up in 10 c c. vials, each 1 c c containing 25 mgm of the salt The dosage used in rheumatoid disease so far has been an initial dose of 100–300 mgm and then 50–100 mgm twice each day It seems likely that administration of an adrenal extract orally is not far off

Fourteen cases of severe rheumatoid disease first were treated at the Mayo Clinic with dramatic results Five physicians from other centres, Drs Bauer, Boland, Freyberg, Holbrook and Rosenberg were asked to inspect the results and each was given enough cortisone to treat two cases in their own clinics for two weeks Their results were equally dramatic One bedridden case was walking in twenty-four hours and gained one million red cells in nine days and another who could hardly walk was able to run in eighteen hours.

In all cases, within a few days, sometimes within a few hours, there was marked diminution of articular pain, tenderness, stiffness and later, lessening of the swelling of the joints, there was a sense of

PLATE I

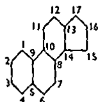


Fig 1 Essential Formula of the cortico-steroids

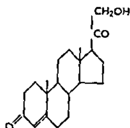


Fig. 2. Desoxy corticosterone

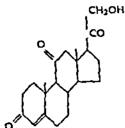


Fig 3 17-hydroxy 11-dehydro corticosterone

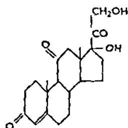


Fig 4 11-dehydro corticosterone

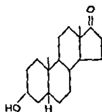


Fig. 5 Androsterone

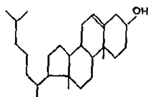


Fig. 6 Cholesterol

To face p

PLATE II

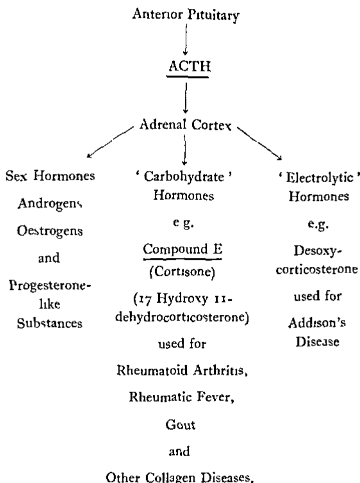


Diagram showing action and uses of A.C.T.H and cortisone.

FIG. 7.

rheumatic syndromes, we find pathological changes in the collagen of connective tissue a possible common factor.

Connective tissues consist of fibres mainly composed of proteins reticular, collagenous and elastic in structure. These are set in an amorphous matrix of acid mucopoly-saccharides and amino-acids. This substrate consists mainly of two constituents, a rigid-gel cement of chondroitin sulphate and a soluble-gel ground work of hyaluronic acids (Bensley, S. H., 1949). Chondroitin sulphate is found mainly in hyaline cartilage, in skin and in tendon, and hyaluronic acid in synovial fluid, in skin and also in hæmolytic streptococci This latter finding is especially interesting in connection with rheumatic fever

The early changes in connective tissue in rheumatic disease has been outlined by Klemperer (1949) as collagen swelling, going on to fibrinoid degeneration and necrosis and later followed by proliferation of fibroblasts He finds these changes common to rheumatoid disease, spondylitis, rheumatic fever, lupus erythematosus, periarteritis nodosa, scleroderma and dermato-myositis

If all these conditions are considered, they have somewhat the same clinical pattern and overlapping cases are seen, but on the other hand the typical syndromes are quite different, and with their difference in prognosis it is certainly advisable to keep them distinct for the present (Bauer, W , 1949)

Collins (1949) in discussing the histology of early changes in rheumatic fever draws attention to the importance of the substrate in determining the number and position of cells in relation to blood-vessels, lowering of density allowing their extrusion further and earlier away from the vessels

The Muco-polysaccharides. As shown above, hyaluronic acid and certain allied muco-polysaccharides are the principal substrate of connective tissue (Mayer and Palmer, 1936) They are carbohydrates built of numbers of saccharide units ($C_6H_{10}O_5$), and may be acted upon by specific hyaluronidase enzymes, which depolymerise and hydrolise, decreasing viscosity and assisting in the spread of foreign agents within the tissues A spreading factor was first described by Duran-Reynals (1931) in connection with vaccinial infection and this was later proved to be due to a hyaluronidase.

The possible significance of the hyaluronidase-hyaluronic acid mechanism in rheumatic disease has recently been well reviewed by Cohen (1949)

When hyaluronidase acts on the *muco-polysaccharides of connective tissue*, the resultant is (1) œdema of both tissue fibres and

that the same type of infective organism has never been isolated in anything like 100 per cent. of cases. The view that there is an allergic factor in etiology facilitates the explanation of the lesions of erythema nodosum, which are probably allergic reactions to the toxins of either hæmolytic streptococci or tubercle bacilli, and it may also account for the lung lesions which occasionally occur in rheumatic fever and which appear and disappear with such suddenness Similarly alternating phases of increased and decreased sensitivity would explain the rapid appearance and subsidence of nodules.

Streptococci may be divided into those producing a true beta hæmolysis and the less pathogenic viridans group. The former are further subdivided by precipitation reactions with extracts of their carbohydrate fractions into Lancefields types A–M. Lancefield A, the type most commonly pathogenic, has been still further subclassified by Griffith, by absorption tests, into twenty-three strains.

Cecil, Nicholls and Stainesbury (1929) obtained a *streptococcus viridans* from the blood of 78 per cent. of cases, but this finding has

lesion and that the other reactions of the tissue which characterise the disease are allergic in nature.

The hæmolytic streptococcus however holds the field as the most likely infective agent. A series of epidemics of sore throats have been carefully observed (Rosenow, 1923) and in about two-thirds of the cases where rheumatic subjects were infected with a hæmolytic streptococcus there was a recrudescence of signs of activity which did not occur in these rheumatic subjects when infection was due to any other type of organism. Similarly, in investigating the histories of Cardiff children suffering from rheumatic fever, (McSweeney, 1931), it was found that 6 per cent. gave a history of scarlet fever immediately preceding the first attack of rheumatic fever.

Coburn, working on the influence of climate on rheumatic fever, found that exacerbations did not occur in rheumatic subjects taken to the tropics, where hæmolytic streptococcal infections of the throat were rare, but that on their return to New York re-infection was followed by a recurrence of the rheumatic symptoms.

The same worker also investigated the skin sensitivity to the hæmolytic streptococcus and found it to be much higher in the majority of rheumatic subjects than in the average normal individual

He believed that rheumatic fever was due to infection of a susceptible subject with the streptococcus, and that both the soil and the seed must be present in order to produce the rheumatic syndrome

When rheumatic children are infected with a hæmolytic streptococcus there is a slower and more prolonged rise in titre of anti-hæmolysin and other anti-bodies than when normal children are affected and this rise corresponds with an increase in Lancefield's M precipitin which denoted the presence of a streptococcus in the tissues (Coburn and Pauli, 1939) Collis (1939) found a hæmolytic streptococcus in the tonsils in nearly every case of rheumatic fever examined post-mortem, although many had given negative smears before death Green (1939) recovered a hæmolytic streptococcus from eight out of nine rheumatic fever hearts but in only two out of twenty-two controls He also found that, in rheumatic fever relapses, 87 per cent of the streptococci isolated belonged to group A while in non-rheumatic subjects with throat infections the percentage of group A was only 42 per cent It is now generally agreed that the Hæmolytic streptococcus type A and C, both of which produce hyaluronidase, is most likely the infective factor in rheumatic fever Hyaluronidase can, as mentioned before, act as a "spreading factor," this effect being partly antagonised by salicylates

Morbid Anatomy. The morbid anatomy of rheumatic fever is that of a widespread agent affecting readily those tissues of mesodermal origin and causing necrosis, muscle fragmentation and infiltration with endothelial cells The typical lesion is seen in the Aschoff's nodes situated around branches of the coronary arteries, between the muscle fibres of the heart, in the sub-endocardial tissue, at the insertion of and in the substance of the mitral valve and at the root of the aorta Of similar pathology are the larger rheumatic nodules found in the subcutaneous tissue and those in the synovial membrane There occurs a small patch of focal necrosis followed by the appearance of mononuclear cells and fibroblasts, the formation of giant cells with nuclei heaped up in the centre of the cell body, and an invasion with polymorphonuclear and eosinophil leucocytes Within a few weeks the reaction subsides, leaving only a small scar in its wake. Collins (1949) found exudation of lymphocytes and polymorphonuclear cells on the fourth day. The exudation was of round cells only and early fibrinoid degeneration had commenced

Carey Combes (1933) stated that in all cases of rheumatic carditis there was some original damage to the cardiac muscle and mitral

that the same type of infective organism has never been isolated in anything like 100 per cent. of cases. The view that there is an allergic factor in etiology facilitates the explanation of the lesions of erythema nodosum, which are probably allergic reactions to the toxins of either hæmolytic streptococci or tubercle bacilli, and it may also account for the lung lesions which occasionally occur in rheumatic fever and which appear and disappear with such suddenness. Similarly alternating phases of increased and decreased sensitivity would explain the rapid appearance and subsidence of nodules.

Streptococci may be divided into those producing a true beta hæmolysis and the less pathogenic viridans group. The former are further subdivided by precipitation reactions with extracts of their carbohydrate fractions into Lancefields types A–M. Lancefield A, the type most commonly pathogenic, has been still further subclassified by Griffith, by absorption tests, into twenty-three strains.

Cecil, Nicholls and Stainesbury (1929) obtained a *streptococcus viridans* from the blood of 78 per cent. of cases, but this finding has not been confirmed. Swift (1924) produced a lesion indistinguishable from an Aschoff node by intracutaneous injection of a "green" streptococcus. He suggests that this is the specific proliferative lesion and that the other reactions of the tissue which characterise the disease are allergic in nature.

The hæmolytic streptococcus however holds the field as the most likely infective agent. A series of epidemics of sore throats have been carefully observed (Rosenow, 1923) and in about two-thirds of the cases where rheumatic subjects were infected with a hæmolytic streptococcus there was a recrudescence of signs of activity which did not occur in these rheumatic subjects when infection was due to any other type of organism. Similarly, in investigating the histories of Cardiff children suffering from rheumatic fever, (McSweeney, 1931), it was found that 6 per cent. gave a history of scarlet fever immediately preceding the first attack of rheumatic fever.

Coburn, working on the influence of climate on rheumatic fever, found that exacerbations did not occur in rheumatic subjects taken to the tropics, where hæmolytic streptococcal infections of the throat were rare, but that on their return to New York re-infection was followed by a recurrence of the rheumatic symptoms.

The same worker also investigated the skin sensitivity to the hæmolytic streptococcus and found it to be much higher in the majority of rheumatic subjects than in the average normal individual.

He believed that rheumatic fever was due to infection of a susceptible subject with the streptococcus, and that both the soil and the seed must be present in order to produce the rheumatic syndrome.

When rheumatic children are infected with a hæmolytic streptococcus there is a slower and more prolonged rise in titre of anti-hæmolysin and other anti-bodies than when normal children are affected and this rise corresponds with an increase in Lancefield's M precipitin which denoted the presence of a streptococcus in the tissues (Coburn and Pauli, 1939) Collis (1939) found a hæmolytic streptococcus in the tonsils in nearly every case of rheumatic fever examined post-mortem, although many had given negative smears before death Green (1939) recovered a hæmolytic streptococcus from eight out of nine rheumatic fever hearts but in only two out of twenty-two controls. He also found that, in rheumatic fever relapses, 87 per cent. of the streptococci isolated belonged to group A while in non-rheumatic subjects with throat infections the percentage of group A was only 42 per cent It is now generally agreed that the Hæmolytic streptococcus type A and C, both of which produce hyaluronidase, is most likely the infective factor in rheumatic fever Hyaluronidase can, as mentioned before, act as a "spreading factor," this effect being partly antagonised by salicylates

Morbid Anatomy. The morbid anatomy of rheumatic fever is that of a widespread agent affecting readily those tissues of mesodermal origin and causing necrosis, muscle fragmentation and infiltration with endothelial cells The typical lesion is seen in the Aschoff's nodes situated around branches of the coronary arteries, between the muscle fibres of the heart, in the sub-endocardial tissue, at the insertion of and in the substance of the mitral valve and at the root of the aorta Of similar pathology are the larger rheumatic nodules found in the subcutaneous tissue and those in the synovial membrane. There occurs a small patch of focal necrosis followed by the appearance of mononuclear cells and fibroblasts, the formation of giant cells with nuclei heaped up in the centre of the cell body, and an invasion with polymorphonuclear and eosinophil leucocytes Within a few weeks the reaction subsides, leaving only a small scar in its wake. Collins (1949) found exudation of lymphocytes and polymorphonuclear cells on the fourth day. The exudation was of round cells only and early fibrinoid degeneration had commenced.

Carey Combes (1933) stated that in all [illegible] eumat[illegible] itis there was some original [illegible] scle [illegible] tral

he valves of the heart are due to the deposition of platelets and n on the endocardial covering of the valve at the point of ıre, the nourishment of the endocardium being impaired as the :t of the formation of Aschoff bodies in the substance of the :. This fact is borne out by the relative frequency of affection e different valves of the heart in proportion to their vascularity, ıoxious agent being probably transported to the substance of 'alve by the coronary arteries.

ıe changes in the joints in rheumatic fever are similar in patho- to those in the other rheumatic lesions, only varying in relation e type of tissue affected There is thus an exudation of serum ibrin into the serous cavities and loose tissues, and it is this :tion which appears to react so well to salicylates In the synovial brane of the joints the typical tissue reaction, similar to that of .schoff nodes of the heart, may be found

th regard to the pathology of the lung lesions which occur g the course of rheumatic fever, there is no unanimity of ɔn. Some are probably due to a non-specific broncho-pneu- ι, while others are believed, owing to the suddenness of their and resolution, to be caused by massive collapse, but may equally ıe due to an allergic reaction, a true rheumatic pneumonia.

nical Description. Rheumatic fever in its broadest sense ıe arbitrarily subdivided into four syndromes, acute and sub- rheumatic fever of childhood and acute and subacute rheu- n of young adults In each, exacerbations usually follow seven rteen days after a nasopharyngeal infection or tonsilitis and especially the acute forms, responds to salicylates. In adults, er, the arthritic symptoms predominate, while cardiac involve- rashes and nodules become progressively more rare.

te Rheumatic Fever A typical syndrome of the acute variety dhood may be cited as an example.

ıild, aged about eight, complaining to her mother occasionally ving pains in the legs and possibly being a little off her food ɔre easily tired than usual, wakes up one morning with more pain, particularly on any attempt at movement, in say, the .le, and this joint is slightly reddened and swollen. The child tle flushed, is sweating profusely and has a temperature of '. and a pulse rate of 110. On general examination a soft movable nodule may be found in the scalp or over one of the

bony prominences at the back of the [illegible] sweating,
spine. On examination of the heart [illegible] eight and
slightly farther out than normal, an increase [illegible]
dullness and particularly of the bare [illegible] of acute
recent dilation, a weakness or muffling of [illegible] diagnosis,
murmur at the apex and an increase in [illegible] carefully
may all signify early cardiac involvement [illegible] questioned
by no means always signify irrecoverable [illegible] of weight
rest the child still stands at least an even [illegible]
particular attack with no recognisable [illegible] st be diag-

If no salicylates are prescribed, [illegible] ually more
another joint becomes swollen and painful [illegible] salicylates
in the ankle has become less acute and [illegible] lesion is in
signs of subsiding. However, as soon [illegible] ungococcal
doses of salicylates the temperature [illegible] mind
disappear, but the pulse rate still remains [illegible] t be made
complete rest in bed For the next [illegible] ic organism
likely to be no change in her [illegible] d the latter
gradually settle and the heart appears [illegible] to become
area of cardiac dullness may gradually [illegible] chronic, by
third sound appear early in diastole [illegible] a failure
often after the active carditis is over [illegible] cause con-
extent regained its tone, take up [illegible] ute onset
murmur and be accompanied by the [illegible] g rest and
mitral stenosis There is some degree [illegible] than acute
white count and sedimentation rate [illegible] somewhat

Sub-acute Rheumatic Fever. In [illegible]
growing pains may be complained [illegible] and peri-
listless, anæmic, losing weight and [illegible] ial diagnosis
On examination, however, he may [illegible] rmal or almost
lesion [illegible] al constitu[illegible]

Acute Rheumatic Fever in the [illegible]
adult the picture is somewhat diff[illegible]
malaise, the temperature rises to [illegible]
several joints, the most frequently [illegible]
and wrists These become red, [illegible]
painful on any movement. If [illegible]
affairs will persist for some week [illegible]
becoming swollen and painful. [illegible]
doses, about gr. xx with sod. [illegible]
usually required for the first [illegible]

joints as a rule subsides rapidly and the pain disappears, the relief of symptoms being accompanied by a fall in temperature. This syndrome is not common after the age of twenty in those who have never previously suffered from rheumatic fever, but quite a large number were seen in the Middle East among British troops during the war. They had to be distinguished from post-gonorrhœal and dysenteric cases, but their response to salicylate was a useful criterion in diagnosis. The majority did not develop new cardiac lesions, although cases otherwise clinically indistinguishable but with past history of rheumatic fever not infrequently had old cardiac lesions re-activated.

In a report by Ferguson on 243 cases (1942), 50 gave a definite past history of rheumatic fever and 64 eventually had or developed definite organic cardiac lesions. Approximately 50 per cent. made a complete recovery, without recurrences during the next twelve months.

Subacute rheumatic infection conjures up the vision of a young adult, often with a past history of rheumatic fever, chorea or growing pains, who complains of general or local rheumatism with occasional slight swelling of one or more joints. The pain is often not very acute, there is no redness, and the swelling is not only slight but often transient There may be some tachycardia and occasionally a valvular lesion develops. A history of tonsilitis is not uncommon a few weeks before the attack On examination the patient appears in fairly good general health, and the sedimentation rate is often normal or, if increased, soon returns to normal It is seldom increased to the same extent as in rheumatoid arthritis. There is usually no marked anæmia.

This is obviously the picture of subacute rheumatism of childhood adapted to adult life; acute reactions in the joints are more rare as are the heart complications; in some cases there is a tendency for slight fusiform swelling of the joints to persist and slight contractures to occur merging into a rheumatoid or periarticular fibrositis syndrome.

Coburn has made an analysis of the symptomatology of 162 cases of rheumatic fever occurring in America and tabulates his findings thus :—

Arthritis in 90 per cent of the cases.
Cardiac involvement 75 per cent.
Epistaxis 50 per cent. Growing pains in muscles 50 per cent.
Attacks of pallor 35 per cent. Severe headaches 35 per cent
Chorea in 28 per cent.

Other symptoms being nausea and vomiting, excessive sweating, pain in lower abdomen, skin lesions, hæmaturia, loss in weight and pneumonia.

Differential Diagnosis. In the fully-developed case of acute rheumatism of childhood there is usually no difficulty in diagnosis, but, unless the condition is kept in mind and the heart carefully examined, nodules looked for, and the patient particularly questioned about growing pains, the cause of general ill-health, loss of weight and slight irregular fever may be far from apparent.

Acute rheumatic fever, when occurring in children, must be diagnosed from acute osteo-myelitis, but this condition is usually more acute, often accompanied by a rigor and is unaffected by salicylates Moreover, a focus of infection may be apparent and the lesion is in the metaphysis of the bone and not in the joint Meningococcal arthritis, scurvy and hæmophilia must also be borne in mind

In the acute rheumatism of adults the diagnosis must be made from gonorrhœal arthritis by examination for the specific organism in any urethral discharge or after prostatic massage and the latter diagnosis is suggested by a tendency for the condition to become localised in a few joints, by a tendency to become chronic, by a concomitant conjunctivitis or iritis and especially by a failure to react to salicylates Gout in a young person may also cause confusion, but a family history of the condition, a very acute onset [illegible]

similar arthritic syndrome may occur

In the subacute form, early rheumatoid arthritis and periarticular fibrositis must be considered in the differential diagnosis The distinguishing features from the former is the normal or almost normal sedimentation rate and the absence of general constitutional symptoms and wasting From the latter the line of demarcation is less well drawn, but the age, a past history of rheumatic fever or a valvular lesion of the heart are suggestive

Prognosis. In a review of children suffering from the rheumatic state, 36 per cent showed evidence of organic valvular disease of the heart If this is avoided and the child can be sheltered from streptococcal infection and prevented from having further attacks the prognosis is excellent. The progression to a polyarthritic state (Still's disease) is rare.

Acute rheumatism in the adult has a good prognosis as cardiac

in a daily dosage of about 1–1·5 gm. during the winter months when streptococcal infections are the most prone to occur (M.R.C War Memo No. 10, 1943) Treatment during an attack produces disappointing results

It is felt by most authorities that an attack of rheumatic fever can be prevented but not cured by chemotherapy. Compound E (cortisone) will, however, produce a sudden remission during an attack (*See* Chapter III).

The treatment in adults varies little from the above except that, cardiac complications being rare, prolonged rest in bed is less frequently required. Salicylates are indicated in *full* doses, sepsis should be eliminated, the throat and sinuses require special scrutiny.

[illegible]

together with the stimulating effect of kathodal galvanism or a sinusoidal current applied by means of a Schnee bath to the extremities, should be tried. Mud packs and hot baths followed by contrast hot and cold douches may also assist in relieving the condition A comprehensive review of the literature on this subject has recently been made by Bruce Perry (1947)

Palindromic Rheumatism

Under this title Hench and Rosenberg (1941) describe a syndrome of recurrent attacks of pain, swelling and redness of one or several joints occurring in adults of either sex. The attacks only last a few hours or days, but may recur over a period of many years There are no constitutional or blood changes and X-rays show no abnormality.

The condition differs from intermittent hydrarthrosis in that the latter condition is usually confined to the knees, there is little pain, and the attacks tend to recur at regular intervals

It is doubtful how common this condition really is, as many cases described under this name are probably cases of episodic rheumatoid. It is stated that biopsy of the joint will give a definite answer, as the inflammation is mainly polymorphonuclear instead of lymphocytic. The number of biopsies from acute early rheumatoid cases is, however, very small and the difference in cellular reaction could be due to the short duration of the inflammatory change.

Treatment with gold is claimed to be of considerable benefit. Boland and Headley (1948).

CHAPTER V

RHEUMATOID DISEASE, STILL'S DISEASE AND CLIMACTERIC ARTHRITIS

RHEUMATOID ARTHRITIS

RHEUMATOID arthritis may be one of the most crippling of all the diseases that are liable to affect the young adult or middle-aged individual, and it frequently taxes the medical adviser to his uttermost to stay its progressive course. It is the thought of the end result of this condition that so often brings fear into the eyes of a patient when her doctor, perhaps inadvisedly, mentions the name arthritis in connection with her malady.

Rheumatoid disease is characterised in the active phase by a general constitutional disturbance, low fever and wasting, associated with a polyarthritis tending to affect symmetrically the smaller peripheral joints and which, unless satisfactory orthopædic treatment is instituted, may end in contractures, subluxations and ankylosis. It usually occurs between the ages of fifteen and forty-five, the average age of onset being forty (Davidson, 1944), and it affects women five times more frequently than men.

Two types are often distinguished but intermediate examples occur. In primary rheumatoid, atrophic or proliferative arthritis, the sex incidence and symmetrical spread is very marked and focal sepsis appears to play a less important part—the soil rather than the seed being the determining factor in causation.

In secondary rheumatoid, focal or non-specific infective arthritis, as it is sometimes called, the occurrence in men is less rare and, although the end result may be identical, the sequence of symmetrical involvement of the joints of the hand, wrists and the elbows is less marked. Removal of an infection of the sinuses, teeth or tonsils is more often found to produce a dramatic improvement.

The tendency at the moment is to increase the "umbrella" of rheumatoid disease to include under one pathology many cases previously classified separately—Still's disease, climacteric arthritis, post infective polyarthritis, episodic arthritis, etc., looking upon the whole syndrome as a metabolic disease started up by a number of factors, on different soil and at different ages. The importance of distinguishing an infective type is that, where such a trigg



FIG 8. Microphotograph of a nodule from a case of rheumatic fever (× 60) showing necrosis and somewhat irregular distribution of epitheloid cells (By courtesy of Dr Hubert Gibson)



FIG 9 Microphotograph of a nodule from a case of rheumatoid arthritis (×60), showing central area of necrosis and symmetrically radial distribution of epitheloid cells and giant cells (By courtesy of Dr Hubert Gibson)

[To face p 3‹

in the majority they were unfortunately less satisfactory. These poor results may possibly be due to the fact that the pathogenic organism has established itself elsewhere, for instance in the gut, or else to the body having acquired a hypersensitiveness to certain organisms that are not normally pathogenic. Keating (1928) found on culture of the fæces of rheumatoid patients that 90 per cent. showed a positive culture of hæmolytic streptococci, whereas in a series of controls only 10 per cent. were positive.

As regards the nature of the infecting organism most of the evidence points to the streptococcus Cecil (1929) obtained positive blood [illegible]

were all negative. Joint culture in 7 cases yielded five positives, two hæmolytic streptococci, one streptococcus viridans, one non-hæmolytic streptococcus, and one diphtheroid bacillus.

Gray *et al.* (1932) grew an alpha-hæmolytic streptococcus (an indifferent hæmolyser) in 74 per cent. of early cases and 42 per cent of late cases All their controls were negative. This streptococcus was stated to be the same type as that obtained by Cecil Positive agglutination reactions were obtained by Cecil in about 60 per cent. of cases and by Keefer *et al.* (1933) in 54 per cent. with 15 per cent positives in controls. Sensitivity tests with streptococcal protein gave 70 per cent. positive with 44 per cent. in controls.

Warren Crowe (1927) believes that the pathogenic organism in rheumatoid arthritis is a *staphylococcus albus* and claims good results with vaccine therapy, while Kauntzer (1925) upholds the *bacillus coli* as the malefactor. Some of the French and Italian schools consider that the tubercle bacillus can cause rheumatoid arthritis. In a few cases it may well be a factor. The literature on this aspect has been well reviewed by Copeman (1943). Taking into consideration the great variety of the conclusions of various workers as to the bacteriology of this type of arthritis, and in view of the fact that many have obtained completely negative results on blood and joint culture, no certain conclusions can be drawn, but if any particular organism is usually concerned it seems necessary to introduce the factor of sensitisation to explain the picture.

The trend of opinion on etiology has however become more biochemical, the infective element being considered only as a trigger helping to upset the endocrine metabolic balances of the body.

Environment The factors here concerned appear to be (1) damp,

PLATE III



Fig. 8. Microphotograph of a nodule from a case of rheumatic fever (× 60) showing necrosis and somewhat irregular distribution of epitheloid cells. (By courtesy of Dr. Hubert Gibson.)



Fig. 9. Microphotograph of a nodule from a case of rheumatoid arthritis (× 60) showing central area of *necrosis and symmetrically radial* distribution of epitheloid cells and *giant* cells. (By courtesy of Dr. Hubert Gibson.)

[To face p.

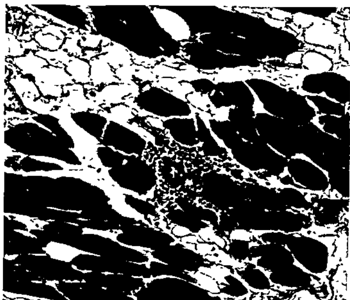


FIG 10 Microphotograph of muscle (low power) in Rheumatoid Arthritis.



FIG. 11. Microphotograph of muscle (high power) in Rheumatoid Arthritis

PLATE V



FIG 12 —Rheumatoid Arthritis—Section of synovial membrane showing collections of lymphocytes (By courtesy of R K Ghormley)

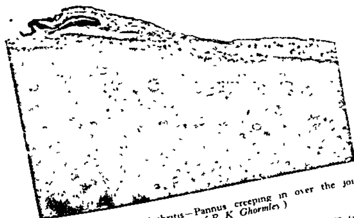


FIG 13 —Rheumatoid Arthritis—Pannus creeping in over the joint surface (By courtesy of R K Ghormley)

[To face p 32

PLATE VI

nerve

cellular reaction

blood vessel

FIG 14 Microphotograph of nerve in Rheumatoid Arthritis.



FIG 15



FIG 16



FIG. 17

FIGS 15, 16 and 17 Rheumatoid deformity of hands

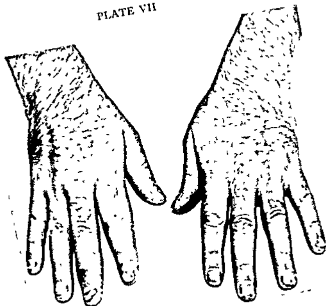


FIG 18 Arthritis with psoriasis

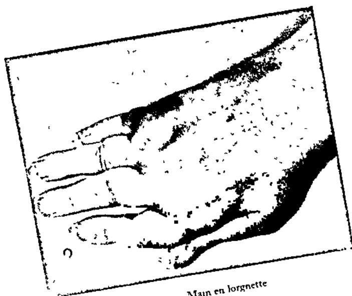


FIG 19 Main en lorgnette

PLATE VIII

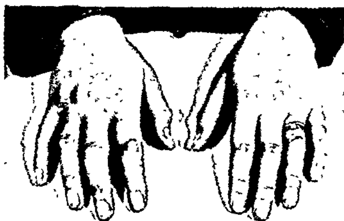


Fig. 20 Fibrous nodes on hands.

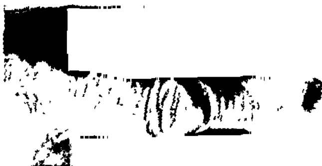


Fig. 21. Heberden's nodes on hands.

(2) changes in temperature, (3) over-clothing, (4) over-fatigue, and (5) slight traumata in the shape of blows or strains.

These factors certainly act when the condition is established in causing exacerbation of the symptoms, probably by producing local congestion and lighting up a quiescent focus in affected structures As determining causes of the disease they probably only act in reducing the resistance of the patient to infection

It is not uncommon to see a typical rheumatoid polyarthritis starting suddenly from a typical mon-articular traumatic arthritis. It seems possible that trauma may sometimes denaturalise the polysaccharides of the joint structure allowing them to become antigenic, forming auto antibodies and thus becoming sensitised.

In 1938 Hench observed that a remission occurred for a number of months during and after an attack of jaundice, whether this was naturally acquired or artificially produced The significance of this is not yet understood. In at least one case the jaundice not only relieved the rheumatic pains and swelling, but also cured allergic manifestations of hay fever. Cases of sciatica have also received relief from symptoms during such an attack.

To summarise the evidence bearing on the etiology of rheumatoid arthritis there appear to be certain people who, on account of their general "make-up" and instability of their autonomic nervous systems, are liable to develop rheumatoid arthritis when infected with certain organisms, to which they probably become hypersensitive. Associated with the condition and increasing the gravity of the disease there is often an endocrine unbalance, which may be th result of the same infective process which has initiated the arthritis There are also certain environmental factors which reduce th resistance of the patient and which also, when the disease is presen are liable to cause exacerbation of symptoms

Morbid Anatomy. In order to appreciate the histopathology joint disease some knowledge of the physiology and histology normal synovial fluid and articular cartilage is necessary Th well reviewed by Davis (1945)

Normal synovial fluid is similar in constitution to plasma, var rapidly in diffusable salt content with that of the blood, but contai also mucus secreted by certain synovial cells and 1–300 macropl per cubic millimetre In pathogenic conditions the sugar co varies inversely as the cell content, and this has been suggeste factor in the rapid necrosis of cartilage in pyogenic infections

The matrix of articular cartilage is hyaline in structure and,

fibro-cartilage, repair is uncertain and at best slow. It contains neither nerves nor blood vessels, pain when present probably being due to bone pressure or involvement, and nourishment being supplied to the surface, in the periphery by blood vessels in the synovial membrane, and centrally by the synovial fluid. To the deep aspect it is carried by vessels in the bone marrow. The matrix probably consists of collagenous and mucinous strata whose greater definition under pathological stress may be responsible for the fibrillation seen in early osteoarthritis (Fisher, 1924). It contains glycogen in quantity varying inversely with the age of the individual and also calcium, normally in a colloidal state, but which under suitable conditions may be precipitated

In rheumatoid disease changes are found in all the mesodermal tissues and the body, in the skeletal muscles, the heart, under the skin, in fat, around nerves, in the synovial membrane and capsule of joints and deep to the cartilage. The changes consist primarily of (*a*) collagen fibrinoid degeneration and later necrosis and fibrosis, (*b*) collection of round cells, mainly lymphocytes, but a few plasma cells and occasionally a giant cell or eosinophil, (*c*) degeneration and proliferation in all the coats of the blood-vessels and (*d*) sometimes secondary degeneration of muscle fibres.

These changes are not considered to be specific but occur much more commonly in rheumatoid disease than in any other condition—in 64 per cent of random muscle biopsies—bears no relation to the wasting of the muscle examined, nearness to an affected joint, the activity of the disease or to treatment, but does vary with the length of the history of the disease.

Recently, Morrison (1949) has shown that degeneration may occur in the axons of nerves, in the anterior horn cells and in the sympathetic ganglia.

Changes in the joints consist of (1) hypertrophy of the synovial membrane with accumulations of lymphocytes or epitheloid cells, focal but not perivascular in distribution, (2) hypertrophy of the connective tissue in the marrow spaces in the subchondral bone, and (3) vascularisation and fibrosis of the joint capsule (Figs. 12 and 13) All other changes—bone atrophy the result of disuse, superficial cartilage erosion by the pannus of tissue spreading in over the surface of the cartilage from the synovial membrane at the periphery, deep erosion by granulation tissue from the subchondral bone marrow spaces, and fibrous or bony ankylosis by fusion and ossification of granulation tissue—all being secondary to these fundamental

processes In addition, changes in the coats, both media and intima, of the blood vessels gradually lead to obliteration and patches of necrosis (Nicholls and Richardson, 1909, and Alison and Ghormley, 1931).

Thus at first there is some engorgement and hypertrophy of the synovial membrane and increase in synovial fluid. A pannus of granulation tissue then creeps in over the surface of the cartilage from the periphery and at the same time it is eroded by a similar process from the deep surface.

If this granulation tissue is present on contiguous joint surfaces, fusion may occur causing a fibrous ankylosis, and this may later be followed by invasion with osteoblasts leading to bony union. Furthermore, hypertrophic villous processes of the synovial membrane may become ossified and detached forming loose bodies, or they may undergo fatty degeneration owing to obliteration of their blood vessels Vascularisation and fibrosis in the capsule may lead later to contraction necessitating surgical intervention.

The inter-relationship of the nodules found in rheumatic fever and rheumatoid arthritis and the specificity of this tissue reaction has been much debated. Dawson (1933) notes similarity in the frequency of occurrence in the two conditions, in about 25 per cent. of severe cases, their common sites on the elbows, knees, ankles and occiput, and their bad prognostic import, while remarking that in rheumatoid arthritis they are usually larger and more lasting, he states that exceptions to this rule occur. In histology these nodules show a central area of necrosis with peripherally arranged epitheloid cells and also a fibrous capsule in which many of the blood vessels have proliferative changes in their coats (Fig 9) In both rheumatic fever and rheumatoid arthritis giant cells may be seen, but in the latter condition the area of necrosis is usually larger and the peripheral arrangement of epitheloid cells is more symmetrically radial Collins (1939), however, feels that neither the fibrinoid connective tissue degeneration, the connective tissue proliferation nor the lymphocytic focal collections found in rheumatoid arthritis are specific, but that they may be produced in connective tissue by other stimuli They may be seen in traumatic teno-synovitis, vitamin C deficiency and granuloma annulare.

The nodule is probably the most specific lesion in rheumatoid disease and is usually recognised with ease, under the microscope from various other types of nodules (Kersley, Gibson and Desmarais, 1946) They may break down forming cysts and chol-

lower the C.S.S., but in a rheumatic condition a marked drop i
indicative of either active rheumatic fever, rheumatoid arthritis, gou
or ankylosing spondylitis.

Another method of estimating the Sedimentation Rate is sometime used in America, the Einstein Rourke technique. This is a calcula tion of the number of mms. drop per minute during the period c most rapid sedimentation. By this method the maximum norm reading is about 0 35 mm.

The plasma viscosity test is also lately used as a criterion c activity It is of value but does not take the place of the sedimenta tion rate The two tests run parallel up to a point, but the viscosity changes are apt to lag behind. A combination of both tests prove a excellent criterion of activity The viscosity is easily measured b comparing the time of flow of the plasma with that of water, an this ratio multiplied by 100 gives a figure in normal people of 160-180. In active rheumatoid disease the reading may be as high a 250 (Woodmansey and Wilson, 1948, Race, 1948).

Boland found that the cerebrospinal fluid protein was ofte increased both in rheumatoid disease and spondylitis and suggeste that this might be due to increased permeability of the choroid plexus.

Differential Diagnosis. The typical case of rheumatoid arthritis is unmistakable, but some of the secondary type, especially those with the acute onset which occurs in about 10 per cent. of cases, require careful differentiation from gout, the acute rheumatic [illegible] Features [illegible] sting, the [illegible] on X-ray with a control of the hands and the general clinical picture, age, sex, history and constitutional symptoms.

Prognosis. The prognosis in rheumatoid arthritis must always be guarded, as, although a certain number of cases make an almost complete recovery with physical treatment and gold therapy or removal of a septic focus, many follow a downhill course in spite of periods of improvement, until many joints are almost completely ankylosed One must always remember the normal vicissitudes of the disease. It has been said, with much truth, that whatever one does, one quarter of one's cases will do well and make a very considerable or complete recovery, half will do moderately well and one quarter will be failures. It must not, however, be forgotten that the suffering of the patient may be greatly alleviated and

that the ultimate result may be much improved by controlling the position of ankylosis of the various joints affected.

would certainly have become the seat of complete ankylosis. Even in advanced cases the power of locomotion may be regained after its absence for some years, by the gradual straightening of knees, use of a calliper and the opening out of fingers to a sufficient degree to allow the grasping of a stick

Treatment. Few diseases call for more patience and resourcefulness on the part of both the doctor and the patient than rheumatoid arthritis. The wide selection of so-called remedies renders the choice of the one best suited to the needs of any particular case a difficult one, calling for both thought and experience.

A very careful history and examination is first indicated and all possible factors in causation assessed The patient is put on a *general regimen* of rest, fresh air and good food Pain is eased if necessary with sedatives, so that sleep may be obtained and the appetite recover, obvious sepsis is eliminated and local treatment given to the affected joints At the same time the psychological background should be investigated. Only then should the question of more drastic surgical procedures, gold therapy, vaccines or protein shock be considered

Rest, both mental and physical, is most important in the active phase of rheumatoid arthritis. The general treatment should not be unlike that of a case of pulmonary tuberculosis The diet should be nourishing and contain plenty of vitamins and calcium. An improvement not infrequently follows a drastic change in the patient's basic foods, such as a temporary reduction in meat and increase in fruit, salad, green vegetables, preferably uncooked or only lightly cooked, and plenty of milk Pain is best relieved by local treatment and aspirin, calcium aspirin or veganin A regular small dose of luminal three times a day is helpful in some cases

Local treatment in the acute stage consists of splintage, which must be removed daily for treatment by mud packs or other form of heat and perhaps some gentle effleurage or anodal galvanism. During this time the joint should be put through as full a range of movement as can be easily carried out, once in each direction Sometimes a little faradic stimulation or static contraction of neighbouring muscles may be helpful Relaxation of muscle spasm should be obtained by

perhaps swelling in a few joints, is arresting progress. The knee affords a common example of this, when it is so painful that it prevents even the use of a calliper. A course of deep X-rays, perhaps three treatments spread over a couple of weeks and followed up by a similar course six weeks later, will often reduce swelling and, in particular, remove the pain formerly experienced on the slightest movement.

Hot baths of various types are used to increase comfort and also to produce sweating in those not too debilitated, and it is surprising how some of the frigi-sensitive patients respond to this hydrotherapy. What would depress one individual will stimulate another, and it is this latter effect that is to be aimed at. The type of bath and mode of application must therefore be modified accordingly. As previously stated, dysfunction of the capillaries of the skin play a large part in the rheumatoid syndrome and every effort must be made to re-educate the circulatory mechanism to heat and cold adjustment. With this in view, contrast sprays are an important adjuvant, but the combination of alternating heat and cold must leave the patient with a glow reaction, neither relaxed nor chilled

Focal sepsis is of importance in some cases, and especially in the secondary type of rheumatoid arthritis the effect of removal may be dramatic The more detailed discussion on likely foci and when to deal with them is included in the chapter on special treatments, as it applies equally well to many other rheumatic conditions.

Colonic lavage is employed by some on the grounds that they believe that infection and toxic absorption is frequently present in the bowel Where there is a history of onset or exacerbations, following bowel irregularities, a short course of lavage in conjunction with diet *regimen* and regulation of aperients is often helpful.

Transfusion and insulin have been used as a non-specific treatment for debilitated cases. The patient first receives two transfusions of 500 c c of blood at a week's interval, and this is followed by a three *weeks' course of insulin therapy, starting with a dosage of 5* units before lunch and dinner, this dose being rapidly increased to 10 units twice daily with simultaneous addition of 1 lb. of glucose to the patient's ordinary diet.

Transfusion with two pints of packed red cells is of definite help clinically in those that are anæmic and debilitated. It often temporarily improves the sedimentation rate and albumen : globulin ratio, but its permanent effect, as seen in a follow-up of 50 cases, six *months later, was on the general health of the patient and the*

PLATE XI

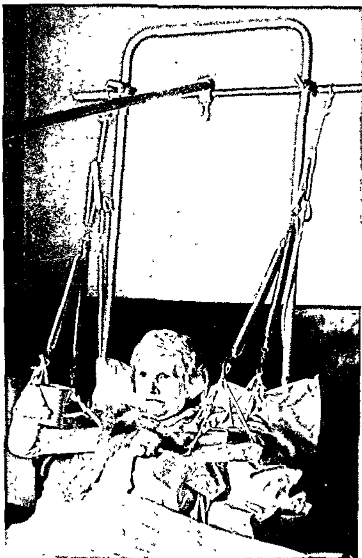




FIG. 24. X-ray of hand showing changes of rheumatoid arthritis and of a normal control. Note osteoporosis and loss of joint space



FIG. 25 *X-ray of hand showing* late changes in rheumatoid arthritis. Note ulnar deviation and subluxation.



FIG. 26 Slings and springs in treatment of Rheumatoid Arthritis of shoulders

PLATE XII



FIG 27.



FIG. 28.

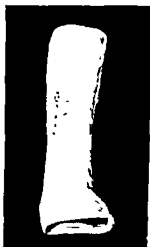


FIG 29

FIGS 27, 28 and 29 Plaster casts for treatment of rheumatoid hand and wrist deformity.

for each case, will at least definitely improve the prognosis and upgrade the results by some 10–20 per cent. The individual approach is essential because the causative factors and general conditions of each case varies so much and also because this gives the extremely important personal contact, which is so necessary if the physician is to give the patient the confidence and moral support that he or she almost invariably needs.

A willingness to rest, confidence and circumstances that will allow of prolonged treatment, sometimes in an institution for several years, will alter the prognosis of the worst case.

STILL'S DISEASE (CHAUFFARD'S SYNDROME)

Still's disease consists of an arthritis and peri-arthritis occurring in childhood, associated with constitutional symptoms, but seldom clinically recognisable signs of a cardiac lesion, though a silent pericarditis is not uncommonly found post-mortem. It occurs during the same age period as rheumatic fever, being most common at about six years Male and female children are affected in equal numbers

The etiologic factors, in so far as they are known, are similar to those of rheumatoid arthritis, which condition it resembles in its acute or subacute onset, often with slight fever, following on a prodromal period of ill-health There now seems to be little doubt that Still's disease is a juvenile form of rheumatoid and, as in adult rheumatoid, local wasting is an early and prominent sign, but in the early stages there is a greater tendency for the joint changes to be peri-articular though later some articular destruction may ensue. Osteoporosis is marked, but ankylosis when it occurs is usually fibrous rather than bony The joints are often symmetrically involved in the following order of frequency knees, wrists, elbows, fingers, ankles, spine and hips Some figures, however, give pride of place in importance to the cervical spine next after the hands and wrists (Schlesinger, 1938)

The general signs and symptoms consist of lassitude and loss of weight, slight fever, sweating and sometimes pigmentation There is generalised lymphadenitis, the glands being firm, discrete and not tender, and the spleen is palpable in about 50 per cent. of cases. Nodules may appear in the subcutaneous tissues and occasionally, but infrequently, a valvular lesion of the heart may appear.

A few cases recover completely, approximately 25 per cent die at n early age, and in the majority of the remainder the condition seems

o burn itself out after some three to five years or at puberty. Quite marked clinical improvement then ensues, the appetite improving, veight *increasing, and, with subsidence of swelling* and spasm, a urprising increase in movement may then take place.

Treatment, apart from splintage, physiotherapy and orthopædic rocedures, is disappointing. General measures to increase resistnce and eliminate sepsis are of course indicated The response to alicylates is negligible and to gold less satisfactory than in adult heumatoids. Toxic manifestations following aurotherapy are also nore common in childhood and require careful consideration before uch treatment is embarked upon.

Climacteric Arthritis

Climacteric or villous arthritis has now become a recognised yndrome, consisting of slight swelling, pain and stiffness, usually n the knees, especially after they have been kept for long in one osition. The condition starts in women in whom it is most common etween the ages of 40 and 50, and in men a decade later It is robably a "form fruste" of rheumatoid with some osteoarthritic eatures also At times it breaks out into a true poly-articular arthitis, similar in all respects to rheumatoid disease except for the fact hat decrease in weight is less frequent. In many cases weight is ncreased rather than decreased

Etiology. The etiologic factors are mainly endocrine and were onsidered to be hypo-ovarian and hypothyroidic, with supernposed micro-traumata due to strain, excessive weight, poor posure and prolonged standing. In view of recent work it seems kely, however, that the adreno-corticotrophic hormone of the ituitary may be largely responsible.

Pathological. The morbid changes appear to be that of villous ypertrophy and hyperæmia of the synovial membrane with no joint r bone change visible on X-ray, except in the late cases in which gns of osteo-arthritis may be seen. There is usually an associated se in the sedimentation rate of the blood during the active stages f the disease

Clinical. Climacteric arthritis usually commences with a iffness of the knees or, more rarely, of the wrists or fingers The isability gradually increases and movement becomes painful, partiularly after a period of rest Difficulty is experienced in walking own hill or down steps, and in the more severe cases pain may otrude into the times of rest The joints become slightly swollen

and tender, with a doughy feel on palpation and fine crepitus on movement.

Prognosis. If untreated the stiffness increases, crepitus becomes coarser and in some cases the condition is followed by typical osteo-arthritic changes, but if treatment is prompt and thorough the prognosis is good. It is this type of case that reacts perhaps better than any other kind of rheumatism to physical treatment if used in conjunction with thyroid medication.

Treatment. General treatment is of great importance and consists of lightening mechanical stress due to excess of weight or flat foot, the treatment of varicose veins and the re-adjustment, to the best of one's ability, of endocrine unbalance. With these principles in view the total quantity of the patient's food should be reduced, particular attention being paid to the restriction of carbohydrate and fat, for which fresh green vegetables, salads, etc., may be substituted.

In addition immersion, general radiant heat and vapour baths should be prescribed and aperient and diuretic waters are of value.

The endocrine aspect should be treated according to the clinical indications, weight, dryness of the skin, etc., with thyroid extract given to the limits of the patient's tolerance. A start is made with an initial dose of 1–2 gr. twice a day and this is later reduced to a maintenance dose. Oestrogenic hormones in the form of stilbo-estrol, hexoestrol or menformon, about 3,000 units twice daily, may be administered, and 50 mgm. of adreno-corticotrophic hormone of the pituitary would seem reasonable therapy, but has not as yet had a proper clinical trial. Injections of œstrogenic hormone, œstradiol 10,000 international units twice a week, or the œstrogenic factor of anterior pituitary extract may also be given a trial.

Local treatment consists in the acute stages of rest, if necessary in bed, and at all events by avoidance of all unnecessary standing or walking. The affected joints should be rested by means of bandaging over wool or strapping with elastoplast. Counter-irritation by means of a Scott's dressing, local radiant heat or ionisation, are of value, and this treatment should later be followed by massage and movement.

Mud packs, short wave therapy or diathermy, contrast douches and faradism are all most helpful and, when these fail, a small dose of X-ray will often be beneficial.

hands and soles of the feet, and calcaneal periostitis are also not uncommon.

There may be fever of varying degree and the white count and sedimentation rate may be raised. The complement fixation test, at all events unless carried out with specially prepared antigen, is merely misleading. Even under the best conditions it has been found positive twenty years after an infection when all signs of activity have disappeared, and negative when the gonococcus was isolated from the synovial fluid (Hench, 1939). When carried out in a laboratory, with the requisite facilities, it is said, however, to give a positive result in 80 per cent of proven cases.

Examination of the specimen of urine first passed after the night will often show some threads or pus cells on centrifuging, and a smear after prostatic massage will usually show some white cells if there is any infection. For culture special agar broth reinforced with proteose is necessary and the oxidase reaction should be used for identification of the cocci.

Gonococcal arthritis must be differentiated from rheumatic fever of adults, gout and sometimes from the more acute form of rheumatoid arthritis. If the condition is borne in mind the age of the patient, the absence of reaction to salicylates and examination of the early morning specimen of urine and of a urethral smear for pus cells after prostatic massage, will usually provide the diagnosis, but absence of a history of infection cannot of course be relied on for purposes of exclusion.

With early and improved methods of treatment the prognosis is good in the majority of cases, but a few are very resistant and progress to a fibrous ankylosis with marked contractures. Cases of *fascitis of the plantar and heel regions are especially difficult to* improve by any known form of therapy.

It seems likely that a proportion of gonococcal arthritis cases eventually progress into a true rheumatoid state, the gonococcus itself having disappeared

Treatment. The treatment of gonococcal rheumatism may be considered under the headings of physical and orthopædic treatment, chemotherapy and hyperthermy Sometimes posterior urethral irrigations and prostatic massage are also indicated.

The orthopædic principles discussed in the chapter on rheumatoid arthritis should be applied to all cases with joint involvement. The most valuable physiotherapeutic measures are pelvic and local short wave and galvanism, using the anode for its soothing and osmotic

effects during the more acute stages and the counter-irritant and more stimulant effect of the kathode as the active electrode, if the local condition becomes subacute or chronic

The value of short-wave in this type of arthritis is enhanced by the thermolabile property of the organism concerned

Though Culp (1940) has recorded excellent results with intravenous mercurochrome, sulphathiazole, sulphanilamide or sulphapyridine and penicillin hold pride of place in the field of chemotherapy Various preparations have been used by various techniques with some success Hench estimates cures by this method, which has the advantage of comparative safety, as 60 per cent. The aim is to produce a concentration of the sulphonamide in the blood of 6–10 mgm. per cent. for ten to fourteen days A similar concentration occurs in the synovial fluid. Certain cases cannot take the drug or are sulphonamide fast, and some have actually flared up during its administration Recent results of penicillin treatment have been very encouraging, the dosage employed being five intramuscular injections of 30,000 units each given at three hourly intervals.

Fever therapy is used by injecting T.A.B., 10 or more million, intravenously, or by the more difficult but far more satisfactory method of hyperthermy A good method of T.A.B administration is the injection of 50,000,000 organisms followed, four hours later, by another similar dose Temperatures up to about 102–104 °F. are produced by this means. There is usually a transient relief of symptoms but they often recur later, especially in those cases with a long history of the condition Hyperthermy may be produced by means of the Kettering hypertherm, relying on radiant heat, or by inductothermy. In either case the temperature of the body must be raised to 106–107° and maintained at this temperature for six to ten hours. Two to four sessions are usually required In order to carry out this treatment without a heavy mortality very expert nursing and supervision is necessary The air must be kept circulating and at the right humidity, there must be a continuous record of the rectal temperature, together with frequent pulse and blood-pressure readings Fluids containing glucose and saline and sedatives will be required and facilities for intravenous saline should be always available. Even with th precautions fatalities have occurred, but when expert control vailable the end justifies the means The Mayo Clinic had ne fatality in a series of 2,600 treatments carried out on 620 ench estimated that 90 per cent of cases of acute arthritis are d 60–80 per cent of chronic cases. A further percent-

failures will react to combined sulphonamide and hyperthermy but the risk of the combined treatment, the patient being saturated with the drug before being placed in the machine, is certainly greater.

Post-Dysenteric Arthritis

This condition in many ways resembles the gonococcal form. It is said to occur in about 1–2 per cent. of cases, *especially with Shiga* infections, and the onset may be anything from two weeks to several months after the bowel infection.

Usually one or more of the larger joints are involved, especially the knees, ankles and elbows, but the specific organism can only occasionally be isolated from the synovial fluid A concommitant conjunctivitis occurs in about 50 per cent. of cases.

The joints seldom suppurate and in many cases the lesion is peri-articular, causing an arthralgia with absence of physical signs. The prognosis is good and permanent deformity rarely occurs.

The use of sulphaguanidine in the treatment of dysentery has probably reduced the number of cases progressing to arthritis. When it does occur the reaction to sulphanilamide or sulphapyridine is usually dramatic, salicylates however having no effect.

Typhoid Fever. Rheumatic complications are not common but they may occur (*a*) in the form of a transient synovitis showing a pure typhoid infection on culture, (*b*) as a monarticular arthritis with copious effusion sometimes stretching the ligaments and causing dislocation, or with secondary infection and suppuration (*c*) as a peri-articular fibrositis, or (*d*) as spondylitis of the lumber spine. Rheumatic manifestations must be differentiated from the more common suppurative periostitis

Any large effusion should be aspirated or any suppurating joint drained and washed out. Otherwise general principles of treatment, as laid down elsewhere, should be followed.

Pneumococcal Arthritis. This usually occurs during the second week of pneumonia. It is frequently monarticular, involving one of the larger joints and results in suppuration in the majority of cases. Aspiration with lavage and sulphapyridine medication are indicated. The joint should be rested in the best position from the point of view of function in case ankylosis occurs, but daily movement should be instituted as soon as the condition permits in order to try and prevent adhesion formation.

Meningococcal Manifestations. These bear a close resemblance to those of the gonorrhœal type and usually appear in the second week of

the disease. They are not common and but rarely become suppurative.

SCARLET FEVER In this condition there may be three types of manifestation. a transient arthralgia usually towards the end of the first week, a later synovitis or periarticular change, and rarely a suppurative arthritis, part of a general septicæmia and pyæmia. The first two forms have a good prognosis and often react to salicylates.

UNDULANT OR MALTA FEVER Both synovitis and fibrositis often occur during the relapses in this condition The pain and effusion is likely to recur with each relapse but permanent joint changes are unusual Spondylitis may follow as a late complication and is said to react to hyperpyrexial treatment (Phalen *et al.*, 1942)

Sulphonamide therapy has so far proved more beneficial than any other form of treatment

Latterly, chloromycetin in a dosage of one capsule of 0 25 gm three hourly for seven or more days is said to have produced excellent results

SYPHILIS. A transient painless effusion into one of the larger joints is not uncommon in the secondary stage of syphilis

In the tertiary stage, either a gummatous infiltration of the synovial membrane or extension of periostitis to the joint, will cause effusion The etiology will again be recognised by the relative lack of pain, and may be confirmed by the Wassermann test

In congenital syphilis there may be a chronic painless synovitis of the knees, with no thickening of the peri-articular structures (Clutton's joints) The diagnosis will be suggested by the age incidence, six to fifteen years, and often by the presence of an associated interstitial keratitis

Charcot's joints occurring in tabes dorsalis are discussed in the chapter on osteo-arthritis

TUBERCULOUS ARTHRITIS. Infection of a joint with the tubercle bacillus is usually characterised by the insidious onset of symptoms, comparative absence of pain, the "white swelling" of the peri-articular structures and decalcification in the X-rays

Etiology. It is usually a blood-borne infection, primarily of the epiphysis, metaphysis or synovial membrane, from a chronic tuberculous focus elsewhere, a minor injury sometimes helping to localise the condition to the particular site

Morbid Anatomy. In children the joint is usually invaded from the epiphysis and occasionally in the hip from the metaphysis, while in adults the epiphysis and synovial membrane are primarily affected with equal frequency.

When the synovial membrane is first involved it becomes œdematous and studded with small gelatinous nodules. Later these become caseous masses which burst into the joint The process gradually spreads inwards over the articular cartilage, which becomes eroded, and the granulation tissue then spreads deeply under the cartilage, sometimes shelling off necrotic flakes. Occasionally there is a large effusion of synovial fluid which contains a considerable amount of fibrin. This may become moulded by the movement of the joint into the so-called melon-seed bodies More often there is but little effusion and the bulk of the clinical enlargement is caused by the extension of the tuberculous process to the peri-articular structures and by the boggy synovial membrane.

When the tuberculous process starts in the epiphysis there is usually a gradual erosion of the cartilage from its deep surface, but occasionally an abscess is formed in the bone and this suddenly bursts into the joint, causing an acute reaction which gradually quietens down and becomes chronic. In a few cases secondary infection with pyogenic organisms occur

Clinical. In children the spine, hip, knee and ankle are most commonly affected, and in adults the elbow, shoulder, wrist and knee. *Females are affected four times more frequently than males* The typical onset is insidious with gradual restriction of movement in all directions in one joint, together with pain on jarring There is little pain in the early stages except when an abscess in the epiphysis *bursts into the joint Later, when the cartilage becomes eroded,* " starting pains " may awake the patient at night, as an unconscious movement allows the rubbing of the eroded surfaces together setting up a spasm of the muscles. There is usually a doughy white swelling of the joint, which is slightly warmer than that on the opposite side. Muscle wasting is marked. Occasionally there is a large effusion, or again, crepitus due to melon-seed bodies may be felt. In the later stages there is slight fever.

X-rays may show a localised osteoporosis, an appearance of widening of the joint space due to loss of outline, and later narrowing, pitting, " thimble " erosions and a general woolly appearance. There may be calcification in the surrounding tissues or signs of formation of a cold abscess, but sclerosis of bone does not usually occur unless there has been a secondary infection.

The end result may be complete cure, fibrous adhesions, bony ankylosis or death associated with cachexia and secondary pyæmic infection The prognosis depends on the stage at which treatment

is started and the resistance of the patient, the very young and very old being particularly susceptible.

Treatment. Treatment will consist of general sanatorium regimen, complete local rest in plaster or splintage, often with slight traction and in the optimum position for function in case of ankylosis, and surgery. The latter may include arthrotomy, arthrectomy, excision and amputation, but works on surgery should be consulted for further details on this subject.



FIG 30 X-ray of hand in osteo-arthritis showing formation of a Heberden's node on the middle finger



FIG 31 X-ray of a hip joint in osteo-arthritis Note narrowing and irregularity of joint space, spreading of the head of the femur with osteophyte formation at the upper margin of the articular surface and areas of rarefaction, often clinically associated with "bone pain"

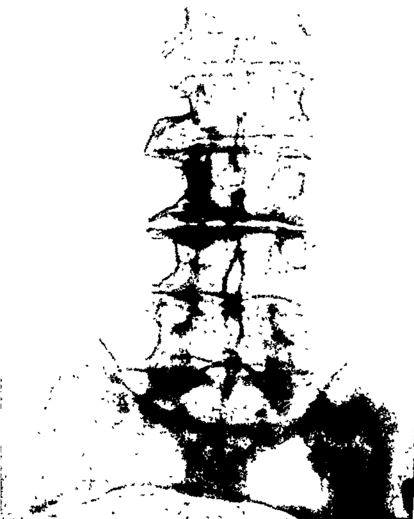


FIG. 32. X-Rays of Osteo-arthritic Spine.



FIG 32 —Osteo-arthritis—Areolar tissue proliferation in the cystic area
(*By courtesy of R K Ghormley*)



FIG 33 —Osteo-arthritis—Fibrillation of articular cartilage
(*By courtesy of R K Ghormley*)

is widening and increased calcification of the subchondral bone plate, with proliferation of the fibrous tissue in the marrow cavity, sometimes leading to bone absorption and an appearance resembling cyst formation. There may be some increase in synovial fluid and proliferation of the synovial membrane, but a growing in of pannus over the cartilage does not occur, and hence ankylosis does not result. At the periphery of the cartilage, where there is a better blood supply, there is a compensatory proliferation of cells with subsequent ossification and production of osteophytes. When the bone itself is exposed to pressure and friction, condensation and eburnation occur Eventually, as the result of alternate destruction and new formation, the joint surfaces may become completely altered in shape.

Clinical. Osteo-arthritic changes, obviously of long standing, are often found when a patient is X-rayed for symptoms of short duration, or when a film is taken to investigate some unassociated condition, such as renal excretion or carcinoma of the stomach. The pathological changes are often confined to one or two of the larger weight-bearing joints or to some joint previously subjected to injury or disease. The clinical onset is usually insidious, commencing with painful limitation of certain movements, coupled with some muscular wasting. This wasting, if severe, causes instability of the joint, which leads to further trauma, thus setting up a vicious circle. In some cases, however, the condition is ushered in by an attack of concomitant acute fibrositis. In a few, severe aching pain, worse at night—typical bone pain—is the predominant feature and, in these, X-ray examination frequently shows cyst formation in the cancellous tissue Sometimes the smaller joints, such as the terminal inter-phalangeal joint of the thumb, are affected In this case Heberden's nodes, periosteal new bone formation at the proximal end of the dorsal surface of the distal phalanges, are frequently found Initially they are usually tender and they later produce unsightly hard fixed swellings. When the metatarso-phalangeal joint of the big toe is involved, the condition of hallux rigidus results, pain and limitation of dorsiflexion making walking extremely painful, except with the aid of a metatarsal bar over which the foot can rock Sometimes the onset of the polyarticular form of osteo-arthritis may be comparatively acute with slight rise in the sedimentation rate, but the age and facies of the patient, the absence of general systemic symptoms or trophic skin changes, the lack both of fusiform swelling and osteoporosis on X-ray, usually make the diagnosis clear

Meanwhile diathermy, short-wave or infra-red heat should be applied and, if a hot pool is available, the prescribed exercises should be carried out under water to reduce weight-bearing, relax spasm and improve circulation.

If this regimen fails to bring relief, more drastic methods must be employed Where there is severe night pain forage (bone drilling) may produce a symptomatic cure. If abduction is materially limited an adductor tenotomy is often helpful. Where the X-rays do not show gross changes and pain occurs only on certain movements, a manipulation under anæsthetic may be indicated. X-ray treatment is frequently advised and, except in those cases with severe " bone pain," there is often symptomatic improvement There is, however, a danger that this relief from pain may encourage the individual to use the joint more, with the result that this activity may actually hasten the disintegration of the cartilage.

The following more drastic surgical procedures require consideration when other methods fail, their application to osteo-arthritis of the hip joint being chosen for illustration of their uses In unilateral cases an arthrodesis, in these days of improved technique, usually gives the surest and most permanent results, at all events in the young and middle aged When the disease is bilateral an arthroplasty with fitting of a vitallium cup is well worth a trial. While for those patients of over seventy years, either a pseudo-arthrosis or trochanteric osteotomy to correct adduction and improve the mechanics of the joint, is probably best, the latter procedure being the least severe of these major surgical operations The result of cup arthroplasty appear to be about 25 per cent. very good and another 35 per cent good.

Tavernier's operation of denervation of the hip by section of the obturator nerve and the nerve to the quadratus femoris is worth considering where the patient is unfit for major surgery or if pain is the only symptom Capsulotomy may also be performed as an alternative operation. Fixation of the hip with a nail is again useful where arthroplasty or an extensive arthrodesis is not justified.

Where surgery is not possible and where other physical methods fail, crutches are the only answer. A walking caliper is seldom satisfactory for the aged, who have little power to adapt themselves to this impediment.

Charcot's Joints

This is a condition of osteo-arthritis run wild. It results from

a complete sensory loss, such as occurs in tabes dorsalis and syringomyelia The abolition of pain removes all protective spasm of the muscles and all check on movement, so that trauma continues in ever increasing amount until the joint becomes completely disorganised and subluxated

deformity varies largely according to the treatment, but, in the neglected case where rest has not been enforced, there is a gradual increase in the thoracic curve with flattening of the lumbar region. The lower part of the chest is constricted, the abdomen protuberant and, as the costo-vertebral joints become ankylosed, so the respiratory movements become progressively abdominal in type.

The first site to be affected may be the sacro-iliac, lumbar or upper thoracic regions, but the occipito-atlantoid joints frequently escape and therefore some movement of the head is retained. There is usually, however, fixed flexion in the cervical region and therefore, in order to look ahead or upwards, the patient must bend back his trunk from the hips. The disease may remain confined to the spine but spreads to the hip or shoulder joints in about 25 per cent. of cases Occasionally the spondylitis may be a part of a generalised arthritis of the rheumatoid type. Not infrequently the disease progresses as far as a certain stage, often until the spine is completely ankylosed, and then remains stationary. The pain in the back then disappears, but root pains or paralytic phenomena are apt to remain *in statu quo* If severe deformity, particularly in the form of flexion of the hips, has been prevented, the patient will be able to hobble about with a stiff back, but in view of the diminution in respiratory capacity special care must be taken to avoid respiratory infections, of which even the mildest may be of serious consequence Two special clinical types are sometimes described—the Marie-Strumpell syndrome of centrifugal spread of the disease from the spine to the shoulder and hip joints and the Von Bechterew syndrome with marked root pains

X-ray examination, when symptoms first commence, is likely to show no pathological changes, but later a generalised osteoporosis is found and is followed by ossification of the spinal ligaments This ossification is often first seen in the capsular ligaments of the articular processes, producing a tram-line effect on the X-ray. Later the vertebral bodies becomes flattened out at their upper and lower surfaces and waisted in the middle, producing the well-known bamboo spine. The periphery of the intervertebral disc is always ossified but the centre of the disc remains unaltered (Figs. 35 and 36) On autopsy, cardiac changes, especially pericarditis and occasionally aortic and mitral disease is found

Examination of the blood in the active phase of the disease shows a raised sedimentation rate of about 50 mm. at the end of an hour, against a normal of 10–15 mm This is similar to the E.S.R. of

rheumatoid arthritis and may possibly indicate the presence of an infective factor, but spondylitis differs from rheumatoid arthritis in that there is in the former more frequently a rise in the plasma phosphatase from the normal of 0·10–0·20 units to about 0·30 units The significance of this is not known, but it probably only shows that there is a rapid re-arrangement of bone formation going on, a similar or larger rise occurring in rickets, Paget's disease, general sarcomatosis of bone and hyperparathyroidism

Differential Diagnosis. There are a number of pathological conditions of the vertebral column which must be considered in the differential diagnosis of ankylosing spondylitis A syphilitic affection, most common in the cervical region, may cause a localised periostitis, perhaps accompanied by translucent areas in the bodies of the vertebræ due to gummatous formation If the latter are extensive, caries causing marked deformity may occur, and there is often a concomitant chronic meningitis causing pressure on the nerve roots and cord

Old healed tuberculous disease may lead to confusion on X-ray examination, but the lesion is usually confined to the anterior part of the bodies of certain vertebræ and to the intervertebral discs

Kummell's disease is due to injury to the cancellous tissue of one or more vertebræ by trauma There is a latent interval following the injury and then pain in the back and increasing deformity are noticed On X-ray the injured vertebræ is seen to have become wedge-shaped due to disorganisation of the body Sarcomatosis of the vertebræ or secondary carcinomatosis arising usually from the prostate, thyroid or breast, are distinguished by means of X-ray and the recognition of the primary source of the metastases

Mention should be made of possible confusion with the after effects of rickets and the occurrence of Paget's disease when similar and possibly more typical changes will be found in the rest of the skeletal system

Acute infective spondylitis or osteomyelitis of the vertebræ may occur without obvious cause The onset of pain is sudden and it is extremely acute, becoming intense on the slightest movement or on any effort such as defæcation It is usually accompanied by a radiculitis and consequent severe pain in the legs

Hysteria and lumbar fibrositis are not infrequently diagnosed as spondylitis In the case of the former, this mistake is very likely to occur if in the past there has been any osteo-chondritis, but the hysterical make up, absence of loss of weight and normal sedimenta-

Spondylitis Osteo-arthritica

Etiology. This condition is exactly similar in etiology and pathology to osteo-arthritis elsewhere. Degenerative changes in the inter-vertebral discs with secondary osteophyte formation appear to be the cause, and repeated slight traumata together with general wear and tear are of great importance The condition is very prevalent amongst coal-miners who spend much of their time in a stooping position and suffer many small injuries to their backs. Marked lordosis may also be a causative factor owing to the excessive weight borne on the intervertebral facets.

Osteo-arthritis of the spine has been subdivided by some authorities into two types, hypertrophic spondylitis or marginal poly-spondylitis with lipping of the vertebral bodies, and hypertrophic spondylarthritis or osteo-arthritis of the inter-articular (apophyseal) joints

The first type, with osteophytes arising from the bodies of the vertebræ, is by far the most common and the sites of election in this type—C 4–5, T 7–10 and L 3–4 (Shore, 1935)—correspond closely with the zenith of the spinal curves, where the vertebræ are most prone to slide and rotate on each other. Also the common segmental clinical distribution of osteo-arthritic pain, namely, to the tip of the shoulder and down to the point of insertion of the deltoid in arthritis of the neck, and to the front and lateral aspect of the thighs when referred from the lumbar region, suggests these same positions of noxious origin (Fletcher, 1945).

Collins does not consider that this type is a true osteoarthritis, but that the osteophytes are only secondary to disc changes

In arthritis of the inter-articular joints, however, the most commonly affected regions are nearer the junction than zenith of the spinal curves, C 7– T 5 and L 2–4, or else, when unilateral they lie on the concave side of a scoliosis. This type appears only a rare cause of typical osteo-arthritic spinal pain.

Clinical. The subject in this form of spondylitis is again frequently of the male sex, but is considerably older than in the ankylosing type, the majority of cases occurring between the ages of forty and seventy, and most frequently of all between fifty and sixty. Symptoms do not usually occur until late in the disease when well-marked osteo-arthritic changes are already present The patient finds that he is becoming a little stiff and experiences sharp twinges of pain on certain movements, but these pains are not severe, and incapacitation occurs only as a result of pressure on nerve roots or

on the cord itself. On X-ray examination osteo-arthritic lipping is seen to be well marked and may be so far advanced that fusion of osteophytes may cause complete ankylosis, but this is unusual as they are usually curved away from the plane of the joint These appearances are often discovered on routine X-ray examination for some condition unassociated with the spine or when there is a concomitant attack of acute lumbar fibrositis

On examination of 10,000 post-mortem specimens, osteophytes were found even in the younger age groups—in 11 per cent. between the ages of twenty and thirty, in 36 per cent between thirty and forty, in 78 per cent. between forty and fifty, and in 93 per cent in those over fifty (Schmorl and Junghanns, 1932)

Treatment. Osteo-arthritic spondylitis often calls for no treatment unless nipping of nerve roots has caused the onset of pain In this case a support may be called for, but usually improvement occurs with douche massage, exercises in a hot bath, local radiant heat and diathermy These procedures improve the nutrition of the spine, cause relaxation of spasm in the muscles, and relieve any associated fibrositis, and hence may frequently bring about a symptomatic cure, although, of course, the bony changes remain unaltered

individual is restricted as a whole, the purine-forming fraction remaining unaltered, the excretion and presumably formation of uric acid is reduced.

Another abnormality in gouty patients is a deficiency of excretion of 17-Ketosteroids

Just before an acute attack of gout there is a falling off of urate excretion as estimated by the urate: creatinine ratio in the urine, sodium chloride excretion increases and there is a tendency for the blood cholesterol and uric acid to rise. Administration of the adreno-corticotrophic hormone of the anterior pituitary (A.C.T.H.) or of cortisone (compound E acetate) immediately reverses this process, causing a marked excretion of urates and in the case of A C.T.H. of 17-Ketosteroids and retention of salt and the attack is prevented and cut short. Four days after the hormone is stopped there is, however, a withdrawal phenomenon and all the prodromal chemical changes of gout occur, culminating in a severe attack This can, however, be prevented by colchinine administration, which is thought to stimulate the anterior pituitary (Wolfson, 1949) (Fig. 41). (See also Chapter III)

Etiology. A history of gout in the forebears of patients is described in different series as from 22 per cent. to 70 per cent. A familial incidence has also been noticed, for instance three brothers were affected, though neither parents nor grandparents were known to have been sufferers. Males are afflicted more than females in at least the ratio of 10 : 1. Talbot (1946) has explained the hereditary aspect of gout by finding that 25 per cent. of the families of those with gout have a raised plasma uric acid, whether or not they themselves have gout, and also that of these individuals, 80 per cent. are the male members.

Wolfson has put forward the theory that gouty patients have a hereditary tendency to produce an abnormal androgen, which regulates hyperuricæmia and helps to explain the sex and age incidence of clinical gout (Fig. 40). He also showed an impaired ability of gouty subjects to respond to those stimuli which should produce 11-oxysteroids (cortisone, etc) promptly. This explains how any stress which should stimulate the anterior pituitary and adrenal cortex will react in gout to cause an acute episode. These theories are further discussed in Chapter III.

In one series of 54 cases (Gibson and Kersley, 1938) the youngest sufferer was twenty-one, and in as many as 36 per cent the age of onset was between twenty and thirty.

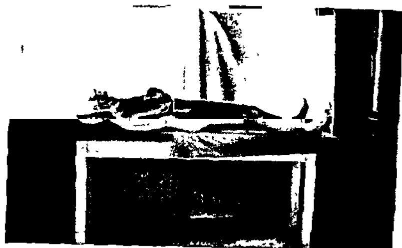


Fig 36.



Fig. 37

Figs. 36 and 37 Photo of a plaster bed with roller skate screws inserted at site of spondylitic deformity so as to allow gradual correction (see text)

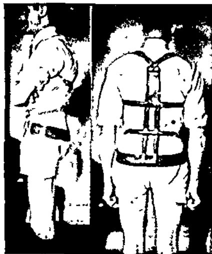


Fig 38. Photo of spondylitic showing fairly well corrected posture and the fitting of a Goldthwaite brace

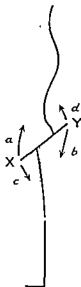


Fig 39 Diagram of the muscular forces acting on the inclination of the pelvis, and of the relationship of Centre of Gravity to the weight-bearing joints
(a) Abdominal muscles, (b) gluteals and hamstrings, (c) flexors of the thigh, and (d) extensors of the spine XY is the plane of the pelvis

Lead intoxication has been quoted in as high a percentage as 25 [illegible]

teeth. Worry and trauma, either by injury or chill, act as triggers in initiating an attack. Idiosyncrasy to certain specific foods or drinks is, however, the commonest of the causes that can be eliminated

Sexual intercourse is also a common trigger in provoking an attack and like the other factors first mentioned, probably acts as a stress, calling for cortico-steroid output, which according to Wolfson, is probably deficient in gout.

There is much to substantiate the quotation from Hedylus Greek Anthology that "The daughter of limb relaxing Baccus and limb relaxing Venus is limb relaxing gout."

The incidence of gout is greater in those of Nordic descent but, in view of the climatic conditions and habits of life which prevail amongst this type, it is doubtful whether this can be considered as a true racial characteristic. Negroes when placed in similar circumstances are by no means immune to the condition Why gout is so rare in Scotland, compared to the rest of Great Britain, is an interesting problem

Morbid Anatomy. The site where urates are first deposited is usually in the matrix of the articular cartilage of a joint just below the surface but, as the condition becomes more extensive, the crystals are laid down in the bone itself and in the peri-articular structures causing some general hyperæmia and thickening of the synovial membrane. *In vitro*, the crystals may be dissolved out of these structures, leaving but little trace of their presence, and a similar sequence of events can occur during life.

Tophi, accumulations of sodium and calcium biurate in a connective tissue and mucinous matrix, are deposited, not only in the region of the joints, but also in the pinna of the ear, in the upper and lower eyelid, in the cartilage of the nose, in bursæ and in tendon sheaths. [illegible]

Clinical. The diagnosis of an acute attack of gout is not difficult; it usually occurs without warning, but may have been preceded by some particular indiscretion of diet or over-fatigue. Typically the

regimen of moderation in all things and to undergo periodic courses of eliminative treatment.

Treatment. The treatment of gout may be subdivided into general hygiene, internal medication and physio-therapy. Under the first category the question of *dietetics* both in regard to quality and quantity is of prime importance. Foods which contain large quantities of purines, such as sweetbreads, fish roes, tripe, whitebait, sardines, liver and kidney should be forbidden. Beverages, such as strong tea, coffee or cocoa, meat extractives and all forms of alcohol are bad, but small quantities of whisky, gin, light red and white wines and cider may be allowed in less severe cases. Any food which the patient knows is liable to cause dyspepsia must be forbidden, and equally important the total caloric value of the diet should be reduced by cutting down carbohydrates and fats There is no harm in ordinary red meats in moderation so long as there is no concomitant hyperpiesis.

It must be realised, however, that apart from these general dietetic rules, idiosyncrasy to certain foods is of great importance, and, in gout, the old saying that 'one man's meat is another man's poison' is particularly true.

The bowels should be kept well open with a small dose of salts in the morning and diuresis should be encouraged with copious soft drinks. Exercise is of great benefit, and a regular round of golf is to be encouraged, although over-fatigue and exposure to severe cold is bad. Any obvious septic focus should, if possible, be removed

... from the use

[illegible]

administration is then stopped for twelve hours and started again with, or without, aspirin three times a day. Each patient should know his own tolerance to this drug and be able to work out his own best dosage. Cases of acute colchicine poisoning have been recorded, but they are very rare and probably due to an idiosyncrasy.

As stated before, A.C T.H. in the dose of 25–50 mgm. or cortisone, will also cut short an attack of gout within four hours and, when followed by colchicine to prevent withdrawal phenomena, will probably become the stock treatment of acute gout in the future.

In the stage between the attacks, colchicine is still very valuable in

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times a day for four days every week in addition to the colchicine is also helpful in some cases and does increase the uric acid excretion in the urine Colchicine can be given intravenously in a slightly higher dosage than by mouth, and will then not usually cause toxic gastric intestinal symptoms.

ATOPHAN. Idiosyncrasy to atophan is a danger that cannot be altogether avoided and a case of jaundice has been seen following the administration of one tablet In view of this, *salicylates* should always first be tried as an alternative. Full doses of sod, sal. xx four-hourly, with an equal quantity of alkali, should be given This will often increase the urinary excretion of uric acid and reduce the blood content, but some cases that will not react to this drug will still have their blood-uric-acid reduced by atophan Where salicylates have failed, where there is no evidence of liver damage or obvious allergy and where the gouty condition appears to be progressive with recurrent attacks, then atophan is indicated, but, especially in the early stages, the closest watch must be kept for toxic manifestations

The usual dosage of atophan (cinchophen) is 7½ gr, that is one tablet, three times a day for three consecutive days every week for a course of about three to four weeks It is best given after food, and the patient should be taking plenty of carbohydrate and calcium at the time. It should not be given if there is any reason to suspect liver damage, and should be discontinued on the onset of symptoms of dyspepsia, jaundice or urticaria After a month the dosage should be gradually decreased to one tablet daily three days a week Atophan is administered intermittently not only on account of its toxicity, but also because the rapid excretion of uric acid that follows its use decreases after the first two or three days. The explanation put forward to explain this is that atophan causes excretion of the uric acid present in the blood and tissue fluids, and that after this store is depleted it is necessary for time to elapse for its replenishment from the deposits in the joints and tophi.

Potassium iodide may sometimes be of use in aiding absorption of tophi, but if these are large they are better removed surgically so long as the incision is made through healthy tissue and not through devitalised skin Diuretic natural waters, such as those of Bath and Buxton, also find a place under internal medication

Local treatment and external applications are confined in the acute stage to the use of a counter-irritant lotion, such as that of aconite, belladonna and chloroform, or to hot and cold fomentations of lotio plumbi or anti-phlogistine. Cold fomentations are of particular

factor often creeps in during and after an attack of fibrositis and may eventually become the sole cause of disability. Boland and Cory (1943) considered that in 33 per cent. of 450 military cases of "rheumatism" the psychogenic factor predominated over the organic.

There are also the theories of fatty herniations and fat œdema (Copeman, 1944) and localised muscle spasm (Elliott, 1944) both discussed below.

Morbid Anatomy. The characteristic reaction of fibrositis, which may or may not lead to nodule formation, according to some observers appears to start as an exudation containing a few lymphocytes and which later becomes organised by invasion with fibroblasts and new blood vessels. This later leads to the formation of dense connective tissue which loses its vascularity as the walls of the blood vessels become thickened gradually to the point of obliteration. The early pathology of fibrositis has so far been but poorly worked out owing to lack of biopsy material.

Sections from so-called fibrositic nodes have, as a rule, shown no characteristic features. In many cases, what was thought clinically to be a nodule has under the microscope proved to be normal connective tissue, a lymph node, or at most, a piece of muscle with increased intra-muscular scar tissue and fibrosis.

Clinically during the initial stage of inflammation pain is acute and examination reveals only a spasm of the surrounding muscular tissue, but later, by means of a deep stroking palpation of the relaxed muscle, a firm nodule may sometimes be detected. This may or may not be tender, according to whether inflammatory reaction is still present or whether nerves are pressed upon. It may be situated in the fascial planes between the muscle fibres, in the subcutaneous tissues, in the capsular structures around a joint or around a major nerve trunk.

Kellgren (1938) has drawn attention to the common fibrositic trigger points from which pain may be referred. He has demonstrated by injection of hypertonic saline that pain from muscle is diffuse in character and may be produced in segmental pattern in a characteristic area for a particular muscle, irrespective of what part of the muscle is affected (Figs 45 and 46). This pain, which is referred to deep structures, is accompanied by deep tenderness. Pain from injection of fascial planes and tendon sheaths is more localised to the point of injection, or to a point slightly distal, and is of a different character. Sheets of muscles with fasciculi separated by fascia have referred pain of an intermediate character.

Gando (1945) however subdivides pain into only two main types, superficial cutaneous pain, pricking or burning in character according to the duration of the stimulus, well localised and stimulating in its effect, and deep muscle pain, aching in character, poorly localised and when deep sometimes associated with no tenderness, radiating according to the embryonic segmental pattern and producing a depressant effect on the organism as a whole Pain produced by an irritant injected subcutaneously is intermediate in character between the two types, while visceral pain is of the deep variety only.

The mechanism of pain production is as yet undecided. We know that scar tissue, whether following trauma or infection, may be the site of " rheumatic " pains varying with the weather But with what factor in the weather we do not know—perhaps the little studied, electrical potential affects the irritability of nervous tissue ?

Copeman and Ackerman (1944) have described a normal basic pattern of fat in the superficial fascia corresponding with the common sites of fibrositic tenderness They consider that tension in this fat, together with herniation of lobules through weak places in the fascia, may be the cause of so-called myalgic spots They are found like Elliott's areas of muscle spasm in the extensor muscles, along the supra-spinatus tendon, in the border of the trapezius, in the sacro-spinalis and in the superficial gluteal fascia just below the crest of ilium. Injections of novocaine will often remove symptoms or, more reliably, excision of a piece of fatty tissue from such an area, though macroscopically and microscopically the fatty tissue may appear perfectly normal, will often remove symptoms even in obdurate cases

Elliott (1944) has recently carried out work throwing some light on a neuro-physiological aspect of the causation of pain in fibrositis. Observing the disappearance of certain " fibrositic " nodules under an anæsthetic, he went on to measure electrical reactions and temperature variations in tender spots arising in muscles in postural strain, psychogenic myalgias and nerve root irritation caused by disc lesions and the pressure of tumours He found that localised tender areas in affected muscles showed not only a hyper-irritability, but also, in many cases, there was a continuous discharge of action potentials at a rate of about eight to twelve per second This was abolished by procaine injection, with relief of pain which lasted for several months, even in one case where the irritation was due to a spinal tumour. The type of electrical reaction was suggestive of an involuntary spasm of small groups of muscle fibres

Contrast heat and cold, both local and general, is one of the most important types of therapy in many cases—the object being to leave the patient with a "glow" reaction and re-educate the neuro-vascular system of frigi-sensitive subjects

Injections of novocain into tender areas has been used in treatment for many years, but Kellgren, as stated earlier, was the first to work out the types of pain and areas of reference arising from the fibrositic "trigger points." These points must first be localised by the type and distribution of the pain, palpation and sometimes by faradic stimulation. A fine needle is then inserted and a little novocain, 0.5 to 2 per cent. according to the quantity to be used, is injected. When the needle is correctly located it usually causes an exacerbation of the original pain, followed by complete relief a minute after some novocain has been injected. It is usually advisable to inject at least two and sometimes as much as 10 ccs., and the point of the needle may be moved slightly in depth and also in the circumference of a circle around the most tender point. After withdrawing the needle it is as well to give a little friction and then instruct the patient to do some exercises to mobilise the part. The permanent effect may be in part due to three factors, the breaking down of fine cobweb adhesions by the fluid injected, by the subsequent mobilisation and by re-establishment of confidence and abolition of habit spasm when the patient finds he can move freely without pain.

Remedial exercises should be employed in treatment in the later stages of all cases to maintain mobility and improve the circulation. In addition, they are of value in remedying postural defect causing unnecessary strain, and in building up weak musculature so as to remove fatigue pain and cramp. In many cases regular back and pelvic tilting exercises will reduce or abolish recurrences of lumbago if used as a prophylactic. It is essential to look beyond the treatment of the particular attack if a satisfactory end result is to be obtained.

PLATE XXI

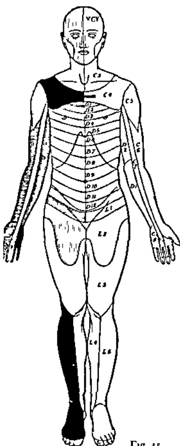


Fig 45

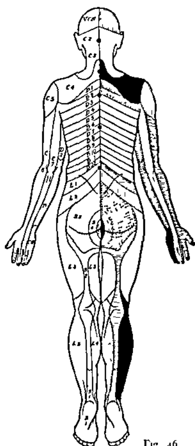


Fig 46

Diagram of cutaneous areas of posterior nerve roots (after Collier and Purvis Stewart Reproduced from Price's *Textbook of Medicine* by courtesy of Oxford University Press

At the Mayo Clinic, out of 5,500 cases of sciatica 13 per cent. were associated with an intervertebral disc lesion and, of these, 80 per cent. are stated to have been cured by operation with a mortality of only 0·25 per cent. (Love and Walsh, 1943). This percentage of cures is certainly higher than that usually observed unless the criterion of cure is the variant factor.

In grouping the causes of sciatic pain, some authors use an entirely anatomical classification, *i.e.*, involvement of fascia, nerve tissue, joints or bone, but a combined physiological, pathological and anatomical grouping seems more useful.

Pain in the distribution of the sciatic nerve may be of two main types: that due to direct involvement of the nerve, the plexus or cord, and that referred from some other tissue or organ of the same segmental nerve supply. In order to obtain information as to which of these sources may be responsible for the pain, both the peripheral and segmental nerve supply of the lower limb must be borne in mind (Figs 45 and 46). As many cases of sciatic pain originate in the region of the sacro-iliac joints, it will be as well to review the nerve supply to these parts (Pitkin and Pheasant, 1936). Weil (1936) goes so far as to say that in the majority of cases primary sciatica arises from abnormality or arthritis of the sacro-iliac, lumbo-sacral, and particularly the fourth and fifth lumbar articulations. The lumbo-sacral and sacro-iliac joints are supplied by the posterior nerve roots of the sacral plexus, and pain is referred from these joints only to a small dorsal area over the sacrum. From the ligaments around these joints, however, pain is referred by the anterior nerve roots to large areas in the leg; from the ilio-lumbar ligaments through L 1, 2, and 3, and from the anterior sacro-iliac ligaments through L 2 and 3 to the front of the thigh and knee, and a small area on the back of the thigh; and from the posterior sacro-iliac ligaments through L 5, S 1, 2 and 3, to the back of the thigh and leg, outside of the leg, sole of the foot and big toe.

Referred Pain. It has been shown that tension in any of these ligaments will produce pain in the distribution of the sensory nerves supplying the same segments, and it is therefore easy to see how fibrositic congestion and small cobweb adhesions between the fasciculi of the posterior sacro-iliac ligaments can cause sciatic pain in the same way as the greater tension of sacro-iliac slip and strain. Likewise pain may be referred *viâ* S 2, 3, and 4 from the rectum or bladder, and from the gluteal region *viâ* L 4 and 5, and S1 and 2. It is probable that fibrositic congestions in the gluteal and lumbar

muscles and posterior sacro-iliac ligaments act as "trigger points" of referred pain. If pressure is applied at these points, pain is felt in some part of the distribution of the sciatic nerve; and if these points are anæsthetised, a temporary cure of the condition often results. Permanent cures following injection of solutions at these points are more the result of freeing fascial planes and rupturing small adhesions than the effect of the chemical action of the solution injected. Referred pain may be very severe, but is not usually associated with such marked wasting or paresis as that sometimes found when direct pressure is the cause. Moreover, the sensory distribution may be helpful in the problem of localisation.

Direct Pressure. Direct pressure may occur on the cord or roots, when the pain will be segmental in distribution, or on the plexus or sciatic trunk. Direct pressure may occur on the cord as the result of neoplasm, tuberculous changes, syphilitic pachymeningitis, or an expressed nucleus pulposus of an intervertebral disc, and is often associated with some paresis, segmental anæsthesia, C.S.F. changes, etc. The nerve roots may be irritated by similar processes, and also by spondylitic and fibrositic changes and hypertrophy of the ligamenta flava (Watson Jones, 1937). The fifth lumbar root (to the

often malignant, of the rectum, prostate or uterus, but if the nerve is already in a state of irritation, even a little overloading of the rectum will result in pain. The trunk, especially as it passes into the gluteal region below the pyriformis muscle (Freiberg, 1936) and throughout the rest of its course, may be involved in a fibrositic process or may be pressed upon by a band (Rendle Short, 1936).

In view of the prevailing interest in *intervertebral disc lesions* in relation to sciatic pain, a more critical review of the evidence is indicated. Beadle (1931) found evidence of a nucleus pulposus prolapsed backwards (in about 90 per cent. of cases in the low lumbar region) in 15 per cent. of post-mortems, but the protrusions were usually insufficient to produce symptoms. Pennybacker and Symonds, as previously stated, consider that the majority of chronic sciatics are due to such lesions and the former has verified their presence in 150 cases at operation. The more conservative observers think that a protruding disc is a factor in 15–25 per cent. of chronic cases. There is no pathognomonic sign or symptom of the condition, but low back pain, sometimes after a strain or injury, followed later

Of the many causes of sciatic pain, probably the commonest is that referred from fibrositic involvement of the posterior sacro-iliac ligaments and gluteal region, rather than that due to direct involvement of the nerve itself. The other causes of sciatic pain must not, however, be forgotten, nor must the frequently associated psychological factor be neglected.

Investigation and Treatment. When undertaking the treatment of a case of sciatica, it is first necessary to take a detailed and careful history from the patient, and in doing so it is possible to assess the mental outlook of the individual. It is particularly important to inquire about previous rheumatic troubles, any trauma, the type of onset of the condition, whether it is entirely unilateral, and about the condition of the pelvic organs. A thorough general overhaul follows, including examination of the urine for sugar or evidence of prostatic trouble, and a rectal and possibly a vaginal examination is made. Local investigation is then proceeded with and evidence of wasting, limitation of movement, tenderness, altered reflexes, contracture of the hamstrings, flat foot, genu valgum, and shortening of the fascia lata noted. In many cases an X-ray of the sacro-iliac region and estimation of the sedimentation rate to exclude early ankylosing spondylitis and congenital defects is indicated. If the only findings are some tenderness in the sacro-iliac and gluteal regions and pain on extending the knee with the thigh flexed (Lasègue's sign), with or without loss of an ankle jerk, treatment should be started on the presumption that the pain is fibrositic in origin.

In the acute stage it is necessary to go very warily. Rest and analgesics are essential, and, for the latter, large doses of aspirin, phenacetin and caffeine, veganin, allonal or veramon are most effective. Occasionally an injection of morphia, heroin or dilaudid may be needed, but it is not to be encouraged in a condition which may last many weeks or months, and when there is often a psychoneurotic background. Physiotherapy is valuable in the form of superficial heat and counter-irritation. Packs of mud or hot 5 per cent capsicum in kaolin and glycerine, plasters, and counter-irritation by high frequency are all of value; but deep heat with the nfra-red lamp or diathermy may in some cases cause the condition o flare up if in an acute stage. Iodine painted on the line of the iatic nerve until the skin becomes inflamed just short of blistering also useful. Helpful as a full-length mud pack from the lumbar gion to the foot may be, applied at as high a temperature as the

patient can bear, left on for fifteen minutes and then sponged off with hot water, it is not at this stage that spa treatment has its greatest value Even more important in the very acute early stages is complete rest, and unless spa treatment and complete rest are compatible, then the latter should have priority. A little later, massage to the sacro-iliac and gluteal region, at first very light and gradually becoming deeper, is invaluable, but much discretion is needed to decide at what stage this is indicated. That the massage be of a really high standard is essential for treatment at this stage, and be it noted a good masseuse is born, not made About this time a reclining bath at a temperature of 100° F, with low-pressure under-water douching at 105° F, is a useful adjuvant, and this is followed up by exercises and sometimes gentle manipulation in a hot pool, into which the attendant descends with the patient At first the manipulation is confined to the lumbar region, with rotational exercises for the sacro-iliac joints, later to be followed by gentle stretching of the hamstrings by extension of the knee with the thigh [illegible]

Mobilisation under an anæsthetic is only indicated at this stage when pain occurs only on movement, thus suggesting adhesions or torsion as the restricting factor.

The manipulation should take the form of flexion and hyper-extension of the lumbar region and, most important of all, rotation. Pitkin and Pheasant (1936) ascribe the benefit obtained from this movement to correction of sacro-iliac slip Watson-Jones (1937), however, lays stress on flexing the hip with the knee extended, and states that the benefit sometimes observed is due to freeing the ham-strings, which may become bound down to the deeper structures

After this procedure the patient is kept in bed for two days, and then allowed up with a sacro-iliac belt, or, what is often equally satisfactory, a strip of non-elastic 1½-in webbing buckled tightly around below the iliac crests. Sometimes a strip of chamois leather between the legs is necessary to keep the belt in position.

At the same time an epidural injection of 80 c.c saline may be made (Slot, 1936), the latter probably acting by virtue of the sudden distension breaking down minute fibrositic adhesions The injection is given with a lumbar puncture needle, which is plunged through the ligaments and then upwards into the sacral foramen. When *in situ*, without using undue pressure, a large quantity of saline can be

may work wonders. Not only may worry be a cause of arthritis, b every chronic sufferer is bound eventually to get some menta fixation element.

Spa Treatment. This psychological factor is one of the reasons why a spell at a Spa is often so beneficial. The patient has a complete change of surroundings, mental and physical rest, an ordered regimen and a psychological uplift due to hope of recovery. In addition, at the Spa all types of treatment likely to benefit the condition should be available and a new and complete review of the state of the disease and the etiologic factors, by a physician experienced in dealing with rheumatism, may easily bring new facts to light and suggest further lines of therapy, that may be continued after the patient's return home. Very essential, however, is the correct psychological approach by the consultant. He must instill confidence and the resolve to fight, without false optimism, and he must at the same time take great care not to shake the patient's faith in the medical attendant to whom he will be returning.

The value of the external application of natural waters rather than tap water is still under debate, and little controlled scientific work has so far been carried out in this field

Taken internally, such "waters" often play an important part in the Spa regimen, but the effect of factors such as the degree of ionisation, the effects of minute quantities of catalysts, radioactivity, etc, have been incompletely investigated. Their known effects on the renal excretion or the gastro-intestinal tract are of specific value in certain cases.

Waters may be grouped under three headings. The thermal radio-active springs rising from a great depth are hypotonic and often calcareous. The temperature at which they rise may make it necessary for them to be cooled before application to the body. They are diuretic and used largely for the treatment of rheumatic conditions, especially gout (Bath, Buxton, Aix, Baden Baden, etc)

Waters containing sulphur vary in their content of sulphide and sulphate. The former is slightly laxative and probably acts also as an intestinal disinfectant and stimulant, and the latter is mainly aperient and a hepatic stimulant (Harrogate, Llandrindod Wells, Apenta, Rubinat, etc.)

Alkaline saline waters are used mainly for gastro-intestinal and cardio-vascular disorders (Leamington, Cheltenham, Vichy, Royat, Nauheim, Kissingen and Karlsbad).

2. Dietetics

The exploitation of diet and nature cures has been a fertile field for the charlatan. The importance of diet cannot however be denied in spite of the fact that it is difficult to lay down definite rules This is because idiosyncrasy to particular foods is an important factor, one man's meat often being another man's poison. Reduction in starchy foods and increase in uncooked vegetables and fruit has been advocated (Hare, 1936), and deficiency of vitamins A, C, and perhaps B, was suggested by [illegible] as of importance in some

fish-roes) should be reduced Reduction in body weight, by general restriction in quantity of food, and especially of sugar, bread, toast and potatoes, may be very helpful in gout, fibrositis, the climacteric type of arthritis and osteo-arthritis The patient is often assisted in keeping to the regimen by starting with a short fast and then by adhering to an exact diet, which should not be over-stimulating to the appetite. Fluids should be taken between and not with the meals. In spondylitis and rheumatoid arthritis, a change in diet is often helpful, but the new diet must be nourishing and contain all the necessary vitamins and mineral elements. When there is any suggestion of gall-bladder dysfunction, limitation of fats and yolk of egg is indicated. (See also Chapter on Gout.)

3. Focal Sepsis

Non-specific infection as an etiologic factor has already been discussed The commonest sites of sepsis are the teeth, sinuses, tonsils, prostate, cervix, gall-bladder and appendix In deciding on the likelihood of an infective factor and the need for radical measures, the type of rheumatism and the history of onset in relation to an infection must both be considered A ten to fourteen days' interval between their onset is extremely suggestive that the infection may be of etiologic significance, as is a slight flare up following interference with the suspected focus.

The Teeth. Perhaps the most difficult decisions occur with regard to the teeth. Conservative treatment by massage of the gums with a tooth-pick, iodine and arsenic application and ionisation should be tried for open infections of the gums, but apical granulomata, dental cysts, infected retained roots and infected unerupted teeth always require radical measures. Infection may occur in the pulp following deep caries but the pulpitis in itself gives no radio-

The Reclining Bath. In balneology it is a common practice to start treatment with a simple reclining bath at a temperature of about 101° F., with an under-water douche at 104° F., for about thirty minutes. This is followed by a rest in a light pack of hot towels for twenty to sixty minutes. The patient's reactions are then observed. One patient may sweat a great deal and feel very tired after the treatment, another may feel hot without sweating, and a third may say that the bath has bucked him up and that it seemed quite cool. This trial bath will be of great assistance in prescribing details of further treatment and assessing the likely future reactions of the individual.

In all cases the patient should be told to "take things slow" during a course of treatment, and especially just after a general treatment These should not usually be given more than three times per week and are, as a rule, best interspersed with local massage, electro-therapy, mud, etc.

The pack after a bath may consist only of a hot sheet or of a varying number of hot towels, wound around the extremities and body The patient lies comfortably on a couch and a cold compress is often with advantage placed around the head. While in the pack, fluids should be given, preferably hot, in order to promote sweating and replace fluids lost.

The Deep Pool is [illegible] at about 101° F [illegible] patient and the [illegible] (Fig. 51). When the patient is severely crippled he is lowered in on a "gantry," a series of slings run out over the bath and let down by some winch or hydraulic mechanism. He may remain in these slings, only those being removed that impede the exercising of the part under treatment, or, now the force of gravity is reduced, he may be able to stand supported by parallel bars running across the pool There is usually a douche pipe connected to a hot and cold mixing chamber and this is used at a temperature slightly higher than the bath for under-water massage. It has a useful preparatory effect in relaxing muscle spasm. After douching, the patient is instructed in exercises, walking re-education or his joints are put through their range of passive, assisted or resisted movements, as indicated on his prescription. During the treatment the hot water ensures the maximum circulation and muscular relaxation in the part. Heating of the water may be carried out by steam, and in one Middle East Military Hospital a pipe from a steam steriliser was satisfactorily used for this purpose.

The pool bath is particularly valuable for manipulations to stretch adhesions in peri-articular fibrositis, for walking re-education and breathing exercises in ankylosing spondylitis, for osteo-arthritic hips and late sciaticas and for reduction of deformity by the serial plaster method in rheumatoid arthritis It is used with success for all stiff joints resulting from trauma and for re-education after paralysis, especially of the spastic type It is contra-indicated, except with special precautions, in heart disease, in those debilitated and in acute or subacute gout In the latter it will usually provoke an acute attack It may be used in debilitated rheumatoids and spondylitics if they are brought by ambulance in their plasters, if the stay in the bath is short and they can have a good rest after treatment. A cool spray after the treatment is sometimes also advisable. Cardiac cases, especially those with an element of nervousness, may often take kindly to this treatment, carefully supervised, if they have had preliminary treatment in a reclining bath to give them confidence

The Deep Bath has a similar object to the pool bath, but is smaller and usually "T"-shaped The manipulator does not as a rule go into the bath himself A gantry holding a chair to be lowered into the water is often provided.

The Hubbard Bath, or tank, is similar to a reclining bath but broader at one end in order to allow freedom for movement and manipulation of the upper extremities (Fig 53)

The Nauheim type is a reclining bath of naturally effervescent water, or one in which this effect is produced by chemical action or by blowing air or carbon dioxide through a perforated pipe under wooden slats in the bottom of the bath It is used mainly for circulatory disturbance and high blood pressure at a temperature of about 101° F., the light percussion effect of the gases or air on the skin causing some dilation of the capillaries and a transient fall in B.P. Given at a lower temperature (about 85° F.), however, this type of bath is a useful general tonic to the system, and is used in cases of debility and in some stages of rheumatoid arthritis

The Whirlpool bath in some ways resembles the Nauheim, but is of more value for its effect on local conditions. Here the water is agitated by a turbine and is often also ærated It was much used during the 1914–18 war for stiff joints

Douche Massage consists of massage and movements while a stream of hot water, usually at 101–103° F., plays on the part. It is particularly valuable for general treatment for widespread fibrositis and pann[illegible]itis and as a tonic treatment It is also used in con-

junction with hot baths for weight reduction. There are two main methods: the Aix type of treatment, in which the patient sits on a stool and the masseur carries a hose over his shoulder which he plays on the part while he works (Fig. 52), and the Vichy method Here the patient lies on a rubber-covered slab while an overhead spray of water descends during the massage treatment.

The Needle Spray consists of a cage of pipes, perforated so that a spray of water is directed on to the patient, who stands in the centre. It may be used as a cleansing or freshening shower after any treatment, as a preliminary to a sweating treatment such as a vapour bath when a patient sweats with difficulty, and, by using contrasting temperatures, as a stimulant and to prevent heat exhaustion. For a patient who cannot sweat easily a spray down at 103° F., a vapour bath and then a spray at 103°–104° F. reduced gradually to 101° F., followed by a pack of hot towels, will usually produce the desired effect As a stimulant and in order to re-educate the skin capillaries in rheumatic conditions, the shower is varied from about 80°–104° F., the range being regulated with the object of producing a final exhilarating reaction. The patient must not be left either feeling limp or chilled.

The Scotch Douche consists of two hose pipes, one carrying hot and the other cold water For its most stimulating effect it should be applied at high pressure in a fine jet up and down the spine, using the hoses alternately. The range of temperature a patient can stand varies greatly with the individual, and it must be regulated to produce the optimum reaction as in the use of the needle spray. The stimulation is partly due to the contrast of the heat and cold and partly to percussion effect.

A Mud Pack, applied as a form of local heat, is one of the most soothing of physical treatments. The pressure on the tissues of the weight of the mud seems to assist in this The mud must be of a homogeneous consistency that will adhere together and mould round the part, and it must retain its heat. Fuller's earth mixed with hot water, or, better still, steam-heated, fulfils these requirements quite well, and physically bears close resemblance to most of the natural peloids No exact temperature is as a rule prescribed, this detail being left to the technician as the sensitivity of the skin of individuals varies so much It is usually advisable to apply the mud as hot as the patient can comfortably bear it, and after the pack there should be a distinct erythema The temperature of the mud is usually found to be in the neighbourhood of 120°–125° F., and a layer at least 2 or

3 ins. thick should be applied and left *in situ* for about twenty minutes. Mud is used as a soothing application for painful joints and is especially valuable in some cases of rheumatic neuritis. Its application is a useful preparation for passive movements, and if a more stimulating effect is desired it may be followed by contrast hot and cold douching Cutaneous anæsthesia is a contra-indication to its use.

As a substitute for mud *hot sand* may be employed, and this can easily be heated over a primus stove when electricity is not available, as is occasionally the case in war time

Paraffin Wax. An excellent method of applying heat to the extremities is by means of a wax bath A paraffin wax, of melting int 110° F., is used at 110°–125° F, and the part immersed in it five r six times. After removal it is wrapped in jaconette and wool or a owel for twenty to thirty minutes. During all this time the skin continues to sweat under the wax, which is afterwards peeled off, and can be used again. The bath should be thermostatically controlled in order to remove the risk of fire or explosions of vapour

Hot Air and Steam Baths Under the category of steam heating come *Vapour* and *Russian baths*, the latter only differing in that the whole person, including his head, is in a steam-filled room. The vapour bath consists of a cabinet from which the patient's head protrudes The bath is usually given at a temperature up to about 160° F. for from ten to thirty minutes, and a cold compress is placed around the patient's head It is particularly useful for those who sweat with difficulty, when it should be preceded by a spray at 103° F and followed by one at 104° F gradually reduced to 101° F., and then by a hot pack and hot drinks

It is also valuable for cases of gout, as it is less likely to provok an acute attack than other forms of general heat. Any tendency claustrophobia is a contra-indication

Greville hot air and *radiant heat* full-length baths are given w much the same precautions as the vapour bath, but the temperat may be raised to the neighbourhood of 320° F

The Turkish Bath consists of a series of rooms at different peratures through which the patient passes The treatme usually accompanied by some massage and a spray

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Plombière Douches and colonic irrigation differ from enemata in that a comparatively large amount of non-irritant fluid is slowly introduced into the lower bowel By the Plombière method there are usually two washings of 1–3 pints each usually given Water

Sod. Bic. or Pot. Permang. Solution is slowly run into the rectum at a temperature of 101°–103° F., care being taken to exclude any air. *The patient retains the fluid for up to ten minutes, lying first on one side and then on the other.* The evacuation is examined and a second washing carried out. Usually the treatment is followed by a reclining bath at 100° F. with a "Tivoli" rose spray under-water douche at 104° F. on the abdomen. This helps to freshen the individual and to allay any colic if the bowel is unduly sensitive.

In continuous colonic irrigation, a two-way tube is inserted into the rectum and, as the fluid enters by the centre tube, it may flow away between the inner and outer tubes. The difference in the results and relative comfort of the two proceedings depend largely on the exact technique employed.

This type of treatment is found useful in conjunction with regulation of diet, aperients, exercise and habit training in cases of chronic constipation, chronic colitis and certain rheumatic and toxic cases, *when there is a history of past bowel trouble, and especially where* exacerbations of rheumatism coincide with attacks of irregularity of the bowels.

The essentials of hydrotherapy for any rheumatism department consist of (1) a small pool or Hubbard tank, (2) a spray massage table, and (3) two hoses with some mixing system for the hot and cold water to each, so that contrast sprays at any desired temperature can be given.

5. Electrotherapy

Physical Principles. The laws governing the distribution of electricity may in many cases be likened to those that govern hydrodynamics. E.M.F. is the "head" of water, the difference between the level of "potential" in two tanks connected by a pipe. The *diameter of the pipe is the resistance and the resultant flow of water* the current. E.M.F is measured in volts, the resistance in ohms and the current in amperes.

Current passes in a solid conductor from atom to atom, but in a fluid containing a salt it travels with the ions, into which part of the *salt solution is dissociated. Thus in a saline solution,* NaCl becomes *broken up into Na and Cl, and, when a current is passed,* the Na ions migrate to the Kathode or negative pole and Cl to the Anode

Types of Current. Currents may be grouped according to their *physical classifications or their medical uses. By the former* method (see diagrams) they are classified as :—

(*A*) Direct continuous flow or galvanic.

(*B*) Direct interrupted (1) slow interruption by a metronome; (2) Leduc variable interruption; (3) surged galvanic current; (4) Morton wave; and (5) static induced currents.

(*C*) Alternating currents: (1) infrequent alternation by a metronome reverser; (2) sinusoidal, (3) faradic; (4) high frequency (including diathermy and short-wave).

(*A*) Direct continuous galvanic current used for destruction of tissue, ionisation, counter-irritation and other specific tissue effects

(*B*) Low voltage varying currents which include slow interrupted and reversed currents, Leduc, surged galvanic, sinusoidal, faradic and remittent currents They are used for nerve and muscle stimulation and testing.

(*C*) High frequency currents used for heating and counter-irritation.

(*D*) Static machine currents, for obtaining contraction of deep muscles

(*A*) *The Galvanic Currents.* A direct and continuous flow of electricity is called a galvanic current In medical treatment it has three main uses, the destruction of tissue by electrolysis or surgical ionisation, specific medical ionisation and non-specific galvanism for counter-irritant, osmotic and analgesic effects

Electrolysis depends on the chemical destruction of tissues by the liberation from salt in solution, of caustic soda at the kathode and hydrochloric acid or zinc chloride at the anode, when a current is passed through electrodes in contact with or embedded in the skin or mucous membranes of the body

except for its terminal ¼ in. is inserted into the tissues at these sites A current of about 6 milliamps is then passed through the needle for about ten minutes

In ionic medication the principle is to repel into the tissues certain ions applied to the skin or mucous membrane Special mention should be made here of ionisation with *histamine* An ointment containing histamine is smeared over the area to be treated

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(*C*) Alternating currents: (1) infrequent alternation by a metronome reverser; (2) sinusoidal, (3) faradic; (4) high frequency (including diathermy and short-wave).

(*D*) Remittent: (1) galvano-sinusoidal; (2) galvano-faradic.

If grouped according to their main uses in treatment, and this is how they will be discussed, they are :—

(*A*) Direct continuous galvanic current used for destruction of tissue, ionisation, counter-irritation and other specific tissue effects

(*B*) Low voltage varying currents which include slow interrupted and reversed currents, Leduc, surged galvanic, sinusoidal, faradic and remittent currents They are used for nerve and muscle stimulation and testing.

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Electrolysis depends on the chemical destruction of tissues by the liberation from salt in solution, of caustic soda at the kathode and hydrochloric acid or zinc chloride at the anode, when a current is passed through electrodes in contact with or embedded in the skin or mucous membranes of the body

A special type of electrolysis is used under the name of acupuncture for fibrositis. Sensitive spots are localised by means of faradic stimulation, a local anæsthetic is injected and then a needle insulated except for its terminal ¼ in. is inserted into the tissues at these sites A current of about 6 milliamps is then passed through the needle for about ten minutes

In ionic medication the principle is to repel into the tissues certain ions applied to the skin or mucous membrane. Special mention should be made here of ionisation with *histamine* An ointment containing histamine is smeared over the area to be treated

and the anodal pad then applied. For the first treatment about 5 amps. for five minutes is usually sufficient, but the dosage is usually pushed until either a slight general flushing or the skin with a feeling of warmth or slight headache is experienced by the patient. This dosage will produce a marked counter-irritant effect locally, together with a weal under the pad. It is used as a treatment for a number of rheumatic conditions. Choline derivatives such as mecholyl are also used to produce a similar but somewhat milder effect.

A galvanic current is usually applied by placing two metal electrodes on a thick, smooth pad of lint wrung out in 1 or 2 per cent. saline and bandaged to the part to be treated.

As an alternative to padded electrodes, cells of a Schnee bath may be used.

The effect of a galvanic current is three-fold: (*a*) Counter-irritant, the reaction sometimes being more marked at the kathode. (*b*) By osmosis tissue fluids tend to pass away from the anode towards the kathode. This is sometimes called kataphoresis. (*c*) A constant current also affects the sensitivity of nerve-endings by a process called electrotonus. The anode is soothing and the kathode stimulating. It may be reasoned from the above that for an acute painful swelling anodal galvanism is indicated, while for more chronic thickenings it is often best to use the kathode as the active electrode

(*B*) *Low Voltage Varying Currents.* These are used almost entirely to stimulate the excitable tissue of the body, nerves and muscles, in order to build them up or re-educate them, to improve circulation, and for muscle-nerve tests. When a current is passed through a normal limb, every time the current is made or broken the motor nerves are stimulated and the muscles contract As the rate of make and break increases from about two to fifty per second, the contraction instead of relaxing completely gradually becomes tetanic. After a peripheral nerve has been cut and degeneration has set in, only the muscle itself is stimulated and for this a frequency of below two per second is required.

A Sinusoidal Current usually alternates with a frequency of about fifty and hence causes a tetanic contraction of normal muscles unless interrupted or surged It may be obtained from an A C. main through a static transformer, as this removes the risk of shock and should reduce the E.M F. to about fifty volts.

An interrupted or surged sinusoidal current is used for strengthening muscles, improving circulation, stimulating metabolism, for

treatment of constipation, and sometimes for cases of chronic "neuritis"

The production of a *faradic current* depends on the principle of induction. When two coils are placed near each other and a current is passed through one, there is a current of very *short* duration induced in the other when the current in the first or primary is made and when it is broken.

A faradic current can be used in most cases for local treatment as a substitute for the sinusoidal and the apparatus required is much more portable. It is valuable in the treatment of any muscle weakness and in conjunction with manipulative treatment. Some clinicians use it with success in the treatment of lumbago, both to ease the condition and to locate painful areas with a view to injection

(C) *High Frequency Currents* A high frequency current is a current that alternates so rapidly that nervous tissue is not stimulated. This requires a frequency of at least 500,000 times per second, the A C. on the main being not more than 500

High frequency currents can be classified for medical purposes under the following headings —

(1) *Long-wave or ordinary diathermy*, frequency 500,000–2,000,000, and wave-length 600–150 metres It is used for heating for medical purposes with a voltage of about 150 and amperage of about 3, and for surgery with a higher amperage with which tissues can be destroyed or "cut." The patient is placed in the resonator circuit

(2) *High Frequency,* so called, is a current similar to the above but with a much higher voltage and lower amperage, and is used largely as a counter-irritant.

(3) *Short wave therapy* has a frequency 10,000,000–100,000,000, and wave-length 10–3 metres Local but penetrating heat may be applied by placing the patient in the "field" between but unconnected to the electrodes, and then a 6-metre wave-length is most usual. Alternatively, the patient may be heated by induction, the method generally used for hyperthermy and in this case a wave-l[illegible] of 20 metres is more suitable.

[illegible] for the formation of H F currents [illegible] separated [illegible] is- [illegible] a coil of low [illegible] ced [illegible] the condenser [illegible] the [illegible] ds and [illegible] This

will be a damped unsustained A.C. By decreasing the capacity of the condenser and decreasing the resistance, and hence length of the coil, the frequency is increased.

The effects of diathermy are those of heat, increase in circulation, relaxation of spasm, relief of pain, etc. It may be used for raising the general body temperature through a few degrees and for local heating of superficial joints for the lethal effect on the gonococcus Its use is often associated with a temporary drop in blood pressure. In rheumatic conditions it is useful for heating the more superficial joints such as the knee, ankle and wrist, and for fibrositis In a so-called " neuritis " it must be used with caution, if at all, as if there is already a peri-neuritis congestion this may be increased with a consequent increase in pain. It is valuable in the treatment of prostatic infections and some cases of cervicitis. Pelvic diathermy is used for gonococcal and sometimes rheumatoid arthritis.

It is contra-indicated in case of thrombosis, where hæmorrhage is likely to occur, when there is loss of skin sensation and if there is any metal buried in the tissues.

The *high-frequency discharge* of low amperage is used either with a glass electrode, a partially evacuated bulb into which is sealed a platinum wire which carries the current, or a " brush." The electrodes are moved lightly over the skin and small sparks from the glass bombard the skin causing a strong counter-irritation A more gentle and soothing effect can be produced by keeping the electrode at a distance at which sparking cannot take place. An effleuve only then passes and this causes only slight reddening of the skin. This effleuve effect cannot as a rule be produced with small portable machines The treatment is useful whenever counter-irritation is indicated

Short-wave Therapy. Two completely different methods of application of short-wave are used, the condenser field and induction methods

In the former, the electrodes are placed at some distance from the skin, usually about ¾ in., and this is ensured by encasing the plates in a glass or ebonite holder. The part between the electrodes then acts as the plate of a condenser, and the field between the electrodes causes the electrons and ions of the tissues to vibrate so rapidly that heat is produced. In short-wave diathermy the oscillations are so rapid that the tissues of low resistance produce so much inductance in the opposite direction that the greater movement—and hence heating effect—is felt in the tissues of higher resistance, the fat and bones.

for acute infections.

In using an induced current, a wave-length of about 20–30 metres is better than the usual one of 6 metres The patient lies on an insulated couch and an insulated coil is either placed on the part or wound around it. It is separated from the skin by a ½ in by some dry material containing no metal objects. The effect of the heat is mainly on the subcutaneous blood vessels and muscles, and hence it is rapidly disseminated over the body causing a general rise in temperature

(D) *Currents Produced by the Static Machine* A Static or Wimshurst machine is an apparatus consisting of revolving glass plates to which are stuck strips of metal foil. A very high voltage is induced on these strips and is collected by brushes connected to two movable brass rods on insulated stands. Two methods of using this current will be considered

The Morton wave is a useful method of producing a sudden vigorous contraction of deep muscle groups and may assist in breaking down small adhesions in chronic fibrositis and sciatica. The negative pole of the machine is earthed and the positive connected to an electrode in contact with the patient. Whenever the potential rises so that a spark bridges the gap on the machine, there is a vigorous twitch of the muscles under the electrode The sparking must be adjusted so that they are infrequent enough to allow complete relaxation between each impulse

The static induced current is used to produce a painless tetanic contraction, which may be surged or interrupted, for deep muscle groups The current flow is of very short duration, about 1/10,000 of a second, and hence does not stimulate the sensory nerves, while the frequency is high enough, but not too high, to produce a tetanic contraction This type of current is produced by bringing leads from both the positive and negative poles of the machine, each through a condenser, to electrodes in contact with the patient.

6. Heliotherapy

Electro-magnetic Waves. Wireless, heat, visible light, U.V R , X-rays and radium emanations are all carried by electromagnetic waves in the ether. They only vary one from another in wave-length, the distance from the crest of one wave to the next, but

this wave-length is measured in wireless by metres and in X-rays in millionths of a millimetre. The velocity of all is the same, so the product of the wave-length and frequency is constant They all also obey the inverse square law, that their intensity varies as the square of their distance from their source. Measurement of wave-length, of all except wireless waves, is usually for convenience given in Angström units, *i e.*, one-ten-millionth of a millimetre.

Wireless waves, which are generated by high-frequency circuits, vary in length from many thousand metres to a decimal of a millimetre The waves given off by a diathermy set are in the neighbourhood of 300 metres and of short-wave or inductothermy in the neighbourhood of 30 metres.

Infra-red heat (4,000,000–7,700 A. units), visible light through the range of the spectrum, red, orange, yellow, green, blue, indigo to violet (7,700–3,900 A.) and ultra-violet rays (3,900–136 A.) are all generated by heating some substance.

X-rays (1,000–106 A) are formed by the impinging of a high-voltage current, passed through a vacuum tube, on the anode.

Heat Rays. Heat waves of infra-red or visible heat rays are given off when any object is heated, whether by burning fuel or passing a current through a poorly conducting material

The wave-length may vary between 4,000,000 and 5,000 A. units, the shorter waves being more penetrating, especially those between 12,000 and 7,000.

An infra-red generator usually consists of a high-resistance wire, imbedded in a non-conducting material such as fire-clay, heated by a current to just below red heat. The heat waves vary between 150,000 and 7,700 A. units with a mean of 40,000 A. units

Radiant heat is usually produced by passing a current through a carbon or tungsten filament in a vacuum- or gas-filled bulb. The electro-magnetic waves given off vary from 40,000 to 3,500 A units with a mean of 10,000 A. units, and are therefore more penetrating than those from a non-luminous source, as they contain a larger source of " short " infra-red rays

The longer wave-lengths only heat the surface of the skin and may in this way act to some extent as a counter-irritant, but those of shorter length (10,000–7,000 A. units) may penetrate to the subcutaneous fascia and will, by heating the blood, cause a rise in general body temperature by as much as 2° F. Heat is therefore used to improve the local circulation, relax muscle spasm, ease pain and raise the body temperature With regard to the question of pain

however, if there is already congestion around nerve endings in the subcutaneous tissues as occurs in some cases of fibrositic perineuritis, the congestion and hence the pain may be increased by the more penetrating forms of heat.

Ultra-violet Rays. U.V. Rays are produced by the combustion of certain materials at a very high temperature created by an electric arc. Their wave-length varies from 3,900 to 136 A units, the longer wave-lengths being the more penetrating.

All sources of ultra-violet light give off waves of mixed length In sunlight there is approximately 80 per cent. heat, 13 per cent light and 7 per cent. ultra-violet rays, although this will vary with the time of day, height of the sun and particularly the atmospheric conditions owing to the absorption of some waves in different proportions to others. The carbon arc lamp gives 85 per cent heat, 10 per cent. light and 5 per cent. U.V.R.

The dosage of ultra-violet light is measured by the erythema produced, at a known distance, on patches of skin of control volunteers A first-degree erythema is slight and disappears in twenty-four hours. A second degree is more severe and is followed by slight peeling. A third degree is associated with œdema, marked heat and irritation, and is followed by marked peeling A fourth degree is characterised by the formation of blisters

U.V.R. may be employed as : (*a*) Counter-irritant, using a second or third degree erythema dose, *e g*, for the relief of pain ; (*b*) to produce pigmentation which is usually associated with a tonic effect, here repeated first-degree erythema doses about two or three per week and using a source of high wave-length such as a nickel carbon arc is best ; or (*c*) to convert ergosterol in the skin into vitamin D and hence improve calcium absorption

7. X-RAY TREATMENT

The striking clinical effect of X-ray treatment used locally on suitable rheumatic cases is diminution of pain and hence of spasm and also reduction of swelling. Finzi and Freund (1943) find that X-rays reduce inflammatory reaction and control exudation. The rays react on the body tissues in varying degrees of rapidity, the most susceptible being the lymphoid tissues, the polymorpho-nuclear cells of the blood, the endothelium of the blood vessels, glandular tissues, the mucous membranes, epithelial structures, and last to be affected is connective tissue, bone and nervous tissue. Examination

this wave-length is measured in wireless by metres and in X-rays in millionths of a millimetre. The velocity of all is the same, so the product of the wave-length and frequency is constant. They all also obey the inverse square law, that their intensity varies as the square of their distance from their source. Measurement of wave-length, of all except wireless waves, is usually for convenience given in Ångström units, i.e., one-ten-millionth of a millimetre.

Wireless waves, which are generated by high-frequency circuits, vary in length from many thousand metres to a decimal of a millimetre. The waves given off by a diathermy set are in the neighbourhood of 300 metres and of short-wave or inductothermy in the neighbourhood of 30 metres.

Infra-red heat (4,000,000–7,700 A. units), visible light through the range of the spectrum, red, orange, yellow, green, blue, indigo to violet (7,700–3,900 A.) and ultra-violet rays (3,900–136 A.) are all generated by heating some substance.

X-rays (1,000–106 A.) are formed by the impinging of a high-voltage current, passed through a vacuum tube, on the anode.

Heat Rays. Heat waves of infra-red or visible heat rays are given off when any object is heated, whether by burning fuel or passing a current through a poorly conducting material

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the presence of a spinal lesion such as an intervertebral disc. This is probably produced by breaking the vicious circle of pain, spasm and ischæmia, which in some cases perpetuates the condition originated by the irritation of the initial protrusion of the disc. Elliott (1944) has found a similar result can sometimes be obtained by breaking the " circle " with novocain injection

The techniques employed vary *ad nauseam*, but can be classified into three main categories: local medium ray and local soft ray therapy and general irradiation To comprehend these differences one must distinguish both quality and quantity in dosage Quality depends on voltage and filtration Quantity, measured in Roentgen units, and defined by the amount of ionisation of the air in a tube and hence the rate of discharge of an electroscope, depends on quality and also amperage and length of exposure.

In the use of rays of medium hardness Van Dam (1938) recommends a dose of 110–130 Roentgen units with a tube of 180 kilovolts at 30 cms distance and with a filter of 0 5 mm copper and 1 mm. aluminium. The total dosage may vary from 400–6,000 r. Weinbrenn (1944), for spondylitis, advocates 800 r. in divided dosage to each side of the spine. Hilton is using approximately eighteen treatments of 300 r. each spread over the spine and sacro-iliac region, the rays being obtained from a 180 Kv -tube and filtered through 1 mm copper and 1 mm aluminium.

Softer rays are used by Fischer (1935) from a 125 Kv tube at 17 cms. with only a 0 3 mm copper filter in a dose of 110 r. Others, however, use an even softer, less penetrating ray produced by 80–100 Kv. with a 2 mm. aluminium filter, in repeated doses of 50 r to a total of 800 r., given in the course of a couple of weeks

Gilbert Scott advocated irradiation of the whole trunk with 100 r. from a 130 Kv. tube with a 3 mm aluminium filter as a curative treatment for spondylitis ankylopoietica, but sufficient controlled work has not yet been published to assess the results.

8. Massage

Massage may be described as the scientific manipulation of the soft tissues in the treatment of disease or injury. The first essential in its prescription is to realise that its effects, according to the way in which it is applied, may be diametrically opposite. Even one type of massage, such as effleurage, may be either stimulating or soothing.

of the bones by radiography shows no beneficial effect following treatment in arthritis; in fact some consider that a more rapid deterioration is seen after treatment than would normally be the case, probably the result of increased use of the joint encouraged by the reduction of protective pain. The symptomatic improvement may therefore be due to diminution of tissue tension, an electrotonic effect on the nerve endings or a direct action on the nerve sheath.

Possibly a general systemic effect also may be a factor. Hilton (1943) found a rise followed by a fall in the sedimentation rate in the treatment of ankylosing spondylitis, an effect rather similar to that seen during aurotherapy. Scott (1939), treating asthma by X-ray to the whole trunk, found that the results were equally satisfactory when the chest was screened with lead. Enough controlled work has not yet been done to decide on the importance of this general effect of X-rays. Possible physiological effects may be summarised according to our present knowledge as (1) an immediate effect on the leucocytes possibly influencing liberation of immune bodies, (2) production of a deep hyperæmia about three weeks later and (3) effects on cell proliferation.

Osteo-arthritis of the hip was the first arthritic condition in which X-ray treatment became fashionable, and it is probably the one which frequently reacts worst to such treatment. In a few cases the result may temporarily be dramatic, though those difficult cases with night pain are usually intractable. Even where there is improvement there is a danger, as suggested above, that the relief may encourage the patient to inflict further traumata on the joint. Cases of rheumatoid arthritis, in which a few joints are holding out against general treatment, often react extremely well to X-rays, the swelling diminishing, pain disappearing and spasm being relaxed so that correction of deformity can be obtained. This relief from pain will often result in more sleep, better appetite and hence increase in weight. Ankylosing spondylitis is often improved by local therapy and this is particularly valuable during the painful period of gradual correction of deformity by serial or wedged plaster beds. Treatment to the sacro-iliac region will often stop painful flexor spasm of the legs when it is present.

Wide field therapy is claimed by some (Scott, 1939) to be curative. In persistent sciaticas, brachial neuritis and lumbago, after careful investigation and other rational treatment by rest, counter-irritation or injection has been tried, X-ray therapy is justified. Relief from pain is sometimes permanent even when there is good evidence of

PLATE XXV

TYPES OF DIRECT CURRENT

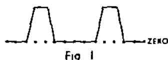


Fig 1

INFREQUENT INTERRUPTION

Interruption by metronome
av 1 per sec

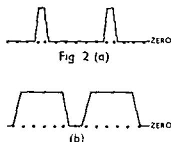


Fig 2 (a)

(b)

LEDUC CURRENT

Freq 100 per sec
either (a) or (b) type of
current may be produced.

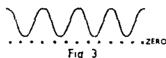


Fig 3

SURGED GALVANIC CURRENT

(Galvano Set)

Freq less than 1 per sec

Figs 1 and 2 show a direct current interrupted or varied by different mechanisms The frequency of the interruptions may also vary in each case but the usual periodicity for each type of current has been stated Thus under the conditions in Fig 1 [illegible]

antagonists show a normal reaction.

is off the foot and a cramp-like pain appears in the shin. At this stage treatment is most satisfactory. Rest from weight-bearing, exercises for the intrinsic muscles, walking re-education and then general mobilising and strengthening is indicated.

The Knee Joint. A stable knee depends above all on intact lateral ligaments and a strong quadriceps. The commonest causes of failure to get a sound knee, after inflamation has subsided, is insufficient rest, while there was an effusion and hence stretching of ligaments, and failure to maintain quadriceps tone. This muscle wastes rapidly and is difficult to build up again when much wasted. Moreover, the vastus internus is often wasted out of proportion to the rest of the quadriceps and hence the direction of pull of the muscle on the patella is thrown out of balance.

This state of affairs must be avoided by the institution of early static quadriceps contractions, sometimes usefully coupled with faradism to the vastus internus. This latter muscle can be selectively contracted by rotating the knee inwards while standing in the erect position. Work with pulleys and weights, a fixed bicycle or rowing machine are all helpful when movement is permitted.

The Hip. In a hip disability, perhaps the commonest being osteo-arthritis, it is extension, abduction and external rotation which must particularly be maintained by means of exercises. These are preferably carried out in a hot pool bath. Here weight is taken off the joint, spasm relaxed and circulation improved. A fixed bicycle with adjustable shank is particularly useful in increasing range of flexion and extension

The Chest. Breathing exercises are of great importance in the treatment of ankylosing spondylitis and are also of value in any posture training and for improving the general health in debilitated conditions such as rheumatoid arthritis.

Firstly, the mechanism of respiration must be fully appreciated. In inspiration the chest capacity is increased by the upward and outward movement of the ribs, which move rather like a bucket handle, and by the diaphragm contracting and descending towards the abdomen. In deep breathing the thoracic spine is also slightly extended, and certain accessory muscles, such as those of the shoulder girdle, and the neck muscles are brought into play. This increase in chest capacity sucks air into the chest. On expiration these muscles relax, and the lungs, with their normal elastic recoil, force a considerable part of the air out again. Then the abdominal muscles contract, increasing the intra-abdominal pressure and forcing the

diaphragm further up into the chest. It is this final expiratory effort which must be taught and insisted on in all breathing exercises, and this coupled with breathing in certain postures that will encourage movement of particular parts of the thoracic cage, are the essence of [illegible] remedial work.

The Shoulder. In arthritis the last shoulder movements to be obtained were abduction and rotation, and these therefore are usually the first to be lost in disease. In periarthritis fibrositis, which is particularly prone to affect this joint, these two movements must be most carefully watched and gradual stretching by manipulation, preferably under water, is frequently indicated. The same care is required after injury elsewhere to the upper limb and in rheumatoid arthritis. It is because of this frequent loss of abduction that an "aeroplane" splint is often indicated in this latter condition.

12. Occupational Therapy

Definition and Scope. Occupational therapy has been defined as the application of occupations, crafts or trades, for their therapeutic effect on the rehabilitation of the mentally or physically unwell, and in assisting the process of return of such individuals to a state of health in which they will be of the maximum benefit to the community.

In its broadest sense it may be said to cover the fields of :—

(*a*) Prescribed treatment for both physical and mental cases ;

(*b*) "Diversional occupation," that is the non-specific use of occupation to employ the mind and body, and hence bolster morale, and increase recovery rate during illness and convalescence ; and

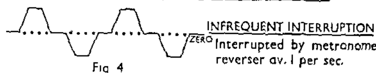
(*c*) Revocational training for those permanently partially disabled.

The use of the term should, however, be restricted to the sense of prescribed treatment.

Occupational therapy can be looked upon as closely related to remedial exercises. Regarded as a means of producing active movement, it has advantages over remedial gymnastics in many cases of physical disability, especially in so far as the upper limbs are involved, and in later stages of treatment. Remedial exercises score in that little, if any, apparatus is required and that some movements may be more exactly localised by specific exercises than by occupations. There are few cases of long-standing disability in which sooner or later the mental factor does not creep in, and [illegible] interesting an individual in a craft, hobby or trade, [illegible] will at same time benefit his condition, the best result

PLATE XXVI

TYPES OF ALTERNATING CURRENT



INFREQUENT INTERRUPTION
Interrupted by metronome reverser av. 1 per sec.

Fig 4

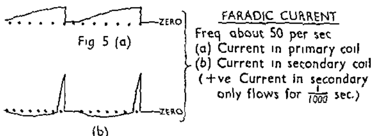
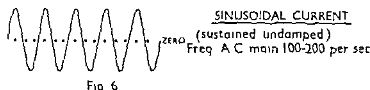


Fig 5 (a)

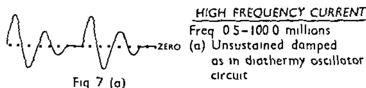
(b)

FARADIC CURRENT
Freq about 50 per sec
(a) Current in primary coil
(b) Current in secondary coil
(+ve Current in secondary only flows for $\frac{1}{1000}$ sec.)



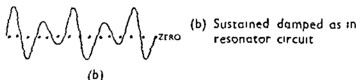
SINUSOIDAL CURRENT
(sustained undamped)
Freq A C main 100-200 per sec

Fig 6



HIGH FREQUENCY CURRENT
Freq 0 5–100 0 millions
(a) Unsustained damped as in diathermy oscillator circuit

Fig 7 (a)



(b) Sustained damped as in resonator circuit

(b)

disease sufficiently quiescent to allow of surgery? Thirdly, has he the physical stamina to withstand the operation or series of operations? If the answers to all these questions are satisfactory, it is next necessary to estimate the stages and time likely to be required and to make sure that there are satisfactory facilities for carrying them through.

Arthrotomy and Lavage. In a number of cases of rheumatoid and villous (climacteric) arthritis, where the swelling does not subside with rest in a plaster, the contents of the joint are much too thick for aspiration, even with a large-bore needle Rapid improvement may occur if the thick, white-of-egg-like contents are removed It is frequently the knee joint which requires this operation The supra-patellar pouch is opened by splitting the fibres of the quadriceps muscle on the inner or outer side, and the material inside the joint is carefully removed from the synovial membrane with a moist swab and then washed away The joint is irrigated with dilute warm eusol, or other non-irritant antiseptic, and then closed A plaster is applied and left *in situ* until the stitches are taken out on the tenth day Static contractions are started on the second day, and after the plaster is removed movement is encouraged, preferably in a hot pool

Synovectomy. Where the bulk of the swelling is due to hypertrophied synovial villi, as much as possible of this surplus tissue may be dissected away and a similar procedure followed to that outlined for arthrotomy and lavage.

Capsulotomy. This is indicated where long standing deformity, usually in quiescent rheumatoid arthritis of the knee, has allowed contracture of the posterior capsule and vessels Gentle stretching after relief of spasm should first be tried, but, if there is no ankylosis and the patella is mobile, failure to react to serial plasters and resistance to extension when relaxed under an anæsthetic, is an indication for open operation The constricted part of the capsule is divided and the knee placed in plaster for ten days. After this, movements must be started, but a split plaster should be worn between treatments for some time in order to avoid recurrence of the flexion

It is often advisable to move down the attachment of the infra-patellar ligament on the tibia at the same time in order to take up the slack in the extensor mechanism of the knee

Osteotomy. This operation is used to correct deformity when ankylosis has already occurred, to improve the mechanics of an adducted osteo-arthritic hip and also in certain cases when severe contracture of the knee will not allow straightening after

Moreover the painful or restricted movement is carried out with the minimum of concentration on the injured part, and is introduced in conjunction with other body movements in the way it will eventually have to be used in normal life.

Prescription of Treatment. When a patient is seen who is expected to benefit by occupational therapy, the medical adviser should write a prescription containing a brief account of the condition to be treated, the movements to be encouraged, the restrictions to be imposed, and any other relevant data. When seen in the occupational therapy department, the individual himself must be assessed as regards his mental capabilities, education and volition, for if he has no interest in the project selected the personality or the instructor or instructress will have to bear the full brunt of engendering this interest. Next the physical aspect must be considered and a project selected, which, while being compatible with the mental attributes of the patient, will conform to the requirements of the prescription

In treatment of rheumatic cases, any craft which requires continuous contraction of muscle groups is usually undesirable. Weaving, braid-woven rug making, basketry and raffia work are favourites for this type of case, but many other crafts may be employed according to the site and stage of the disability. Some experimentation will be necessary with each case in order to aid and not impede the circulation to the affected part. The effect of employment on the mental outlook of the patient may be dramatic, and, in most chronic arthritics, the outlook plays a larger and larger part as the disease progresses. In many cases occupational therapy may pave the way for pre-vocational training and employment in sheltered workshops.

II. SURGERY

No attempt will be made to go into details of orthopædic procedures utilised in the treatment of arthritis, but indications for specific operations will be outlined These must be understood by the physician, that they may take their proper place in the planned campaign so essential for a successful result.

Before embarking on any surgery careful consideration is required Firstly, the psychological make up of the individual must be studied, in order to ascertain whether he " will go through with it," put up with considerable discomfort, carry out regularly all directions, and, particularly, whether he has the will to get well. Secondly, is the

Arthroplasty. In a comparatively young and fit subject th re-making of a joint may be tried. This becomes especially desirab if the corresponding joint on the other side is likewise affected Th operation is usually confined to the elbow, knee or hip in eithe quiescent rheumatoid arthritis or osteo-arthritis The joint surfaces are re-shaped, a fascial layer inserted between the bones and movement is commenced as soon as the skin has healed. If all goes well passive movement may be started in ten to fourteen days and weight-bearing in a brace commenced in three months The brace may be discarded in about six months The use of a vitellium cup has largely replaced other types of arthroplasty in the case of the hip The results in the hands of an expert are 25 per cent excellent and another 35 per cent very good About two years follow-up and exercises are required however to produce these results. This operation has the big advantage over arthrodesis that it does not throw the additional strain on the low back which is liable to produce osteo-arthritis there at a later date The results of arthroplasty for the elbow in rheumatoid arthritis are usually good, but simple excision of the head of the radius may in some cases produce an equally good result. Arthroplasty of the hand is now being carried out quite successfully for rheumatoid deformity

Forage. In certain cases of osteo-arthritis with persistent pain, especially at night, relief may be obtained by bone drilling (Mackenzie, 1936) The way in which this relief is obtained is not certain, but it probably acts by reducing pressure in the cancellous tissue The relief is out of proportion to that obtained by complete rest alone (Kersley, 1938) In other arthritic conditions the results of this operation are disappointing

Excision of the achromial process is worthy of consideration to assist in production of abduction of the shoulder in stubborn cases and *excision of the lower end of the ulna* is of value for stiff, painful wrists

Sympathectomy. Removal of sympathetic ganglia and peri-arterial sympathectomies have been performed in a limited number of cases of rheumatoid arthritis, but the results so far do not warrant the gravity of the operation Hench (1936) considers that it should be judged entirely on its effect of producing a dry warm instead of a clammy cyanosed extremity

Surgery should not be resorted to until the effect of sympathetic-block has been tried and proved to be temporarily but not permanently successful Injection of the stellate ganglion by the

capsulotomy. The part is put in a plaster spica until the bone is firmly united.

Osteotomy is also practised in the lumbar region for severe deformity in spondylitis. The technique, however, is of great importance and the wedge removed should slant obliquely upwards to avoid instability and risk of cord compression.

Arthrodesis. This is an operation to fix a painful and useless joint and was employed as a last resort for the hip or knee in severe osteo-arthritis, and in rheumatoid arthritis for the subastragaloid, mid-tarsal and wrist joints. With improvement in technique, however, satisfactory results are becoming more sure and this operation is now coming to be considered by many the procedure of choice in unilateral osteo-arthritis of the hip for all except the aged. It has been carried out with success even in patients in their 'seventies, shock being combated by transfusion while on the table. An arthrodesis may be performed by extracapsular grafting, but more often the joint is opened, osteophytes removed and the ends of the bones bared and then fixed by a peg or graft. A plaster is applied until union occurs. This may take three to six months and then a calliper must be worn for a further period, as good bony union is difficult to guarantee. When firm, however, providing the corresponding joint on the other side is sound, the functional result is suprisingly good, pelvic movement giving an apparent flexion and extension of 30 degrees.

A simple pin fixation is used for those with severe pain who are unfit for any more serious operation.

Arthrodesis is also the operation of choice in some cases of bilateral rheumatoid arthritis of the knees One painless stiff but stable knee is very little disability and full attention can then be focused on obtaining as good a movable knee as possible on the other side.

Arthrodesis of the base of the thumb is a simple and satisfactory operation and is the best procedure for osteoarthritis of the metacarpo-carpal joint in those who need to carry on with hard manual work.

Pseudo-arthrosis. The removal of the head and neck of the femur for osteo-arthritis of the hip is frequently performed in the elderly, as it entails less shock and a shorter period of recumbency than an arthrodesis, the patient being allowed up and about in a calliper within two months. This operation is also useful in bilateral disease of the hips in ankylosing spondylitis, as arthroplasty does not give a permanent relief in the majority of such cases.

control undue mobility in the latter joint. The weight of the body is transmitted direct from the tuber ischii to the heel of the boot, and a hinge fitted with a series of stops may be used to limit the range of movement in the knee.

A calliper, however, needs considerable muscular power to make its use satisfactory and, in the aged and debilitated, resort to a comfortable pair of crutches may be the best solution to the problem.

Recently, Selye (1949) has found a method of producing a local arthritis in rats by means of injections of formaldehyde and this has helped him to evaluate experimentally the effects of anterior pituitary and adrenal hormones in relation to arthritis and also to the alarm reaction

Pre-treatment with D.C.A (desoxycortone), which is one of the electrolytic, or as Selye calls it, the mineralo-corticoid factors in the adrenal cortex, aggravated the arthritic response to formaldehyde In adrenalectomised rats protection from arthritis was given by cortisone whether administered with or without D.C.A., but joint swelling developed in unpre-treated controls and in those having D.C.A alone A.C.T.H gave protection, but L.A.P (lyphilised anterior pituitary crude extract) increased the liability to arthritis. The alarm reaction to stress, occasioned by fatigue, heat, transection of the cord at the 7th cervical vertebræ and repeated injections of formaldehyde between the shoulder blades, protected fasting rats temporarily from arthritis produced by local formaldehyde injections This protection was presumably due to endogenously produced cortisone.

Seyle also found that A.C.T.H causes involution of the thymus and

certain abnormal circumstances however, perhaps because the production of gluco-corticoids cannot keep pace with the electrolytic corticoids, this useful adaption syndrome may become noxious and the principal cause of the "*collagen*" *diseases, rheumatic, gouty, or hypertensive* Various other factors may assist in localising the eventuating syndrome. It is too early to pronounce judgment on these theories, but they may well

approach is sometimes very successful in the shoulder-hand syndrome.

12. Appliances and Splints

Splintage is used in arthritis to avoid or correct deformity and reduce pain, spasm and effusion. The ideal splint should be light, durable, moulded to avoid pressure, reduce movement to a minimum and yet be easily removable for treatment. The materials in common use are plaster of paris, aluminium, fibre, Kramer wire and various plastics. A skin-tight plaster, if applied by an expert and split when dry, is probably the most generally useful, but for abduction of the shoulder it is usually too heavy. Slings and springs arranged at the head of the bed are very satisfactory for this condition and are described under Rheumatoid Arthritis. The use of plastics, which are light, durable and easily moulded when heated, may in the future largely replace many of the older methods. Application of serial plasters for correction of deformity (Fig. 23) is discussed in the chapter on rheumatoid arthritis and the value of a plaster bed for spondylitis (Fig. 37) and a plaster jacket in sciatica are also dealt with in the sections on these conditions.

A Goldthwaite type of brace is fitted to any sufferer from spondylitis ankylopoietica when he is first allowed up from his plaster bed. It takes its purchase from the sacrum and is held in position by a band running forward below the iliac crests. This band also supports the lower part of an abdominal pad, which is pulled in and up by further straps and which raises the intra-abdominal pressure and improves the respiratory excursion. From the sacrum a moulded back plate ascends to the thoraco-cervical level (Fig 38). In the upper part it is sprung back a little from the usual kyphotic curve, and from its upper end come two straps which run round in front of the shoulders and are then buckled to the back-piece below. No support will maintain a satisfactory posture completely, but this brace supports the sacro-iliac region and the abdomen and the shoulder straps give warning of increasing stoop. When this occurs, they start to cut into the front of the shoulders and it is time for the patient to retire to rest. On no account must they be slackened off to ease the discomfort, or the whole value of the brace is lost. If *the cervical spine is affected a brow band from a steel extension* upwards of the back piece may be added to the brace.

The other appliance of most use in arthritis is the calliper, which may be employed to stop weight-bearing in the hip or knee or

control undue mobility in the latter joint ...

... however, needs considerable muscular power to make its use satisfactory and, in the aged and debilitated, resort to a comfortable pair of crutches may be the best solution to the problem

Recently, Selye (1949) has found a method of arthritis in rats by ... him to evaluat ... hormones ...

Pre-trea ... electrolytic ... is one of the adrenal cortex, aggravated the arthritic response to formaldehyde In the adrenalectomised rats protection from arthritis was given by cortisone whether administered with or without D C A ... in unpre-treated controls and ... gave protection, but L.A.P (l ... increased the liability to arthritis ... by fatigue, heat, transection of ... repeated injections of formalde ... tected fasting rats temporarily fr ... arthritis produced by local formaldehyde injections This protection was presumably due to endogenously produced cortisone.

Seyle also found that A.C T H causes involution of the ... lymphoid tissue, as does ... the other hand, like D ... to suggest that there ar ... one which stimulates th ... and the other, found in ... function of D C.A and ... adrenal corticoids. The ... are to some extent mutu ...

Selye finally suggests that the general adaption ... of alarm and stress ... certain abnor ... of gluco-corti ... useful adaptic ... of the "collag ... other factors ... too early to p ... form the basis of an ur ... measures long practisec ... light on both the use o ... endothelial system and t ...

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